This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

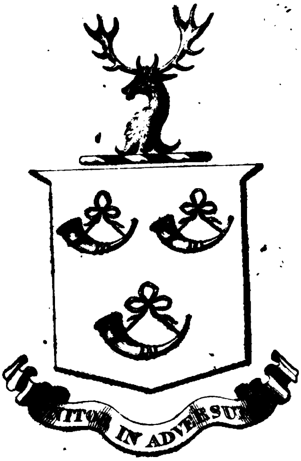
About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

UC-NRLF
B 3 926 003

BERKELEY
LIBRARY
UNIVERSITY OF
CALIFORNIA

~~EARTH~~
SCIENCES



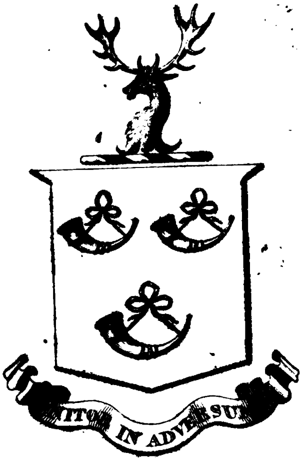
Leonard Horner.

[illegible]

[illegible]

BERKELEY
LIBRARY
UNIVERSITY OF
CALIFORNIA

EARTH
SCIENCES



Leonard Horner.

OUTLINES
OF AN
ATTEMPT TO ESTABLISH
A
KNOWLEDGE
OF
EXTRANEOUS FOSSILS,
ON
SCIENTIFIC PRINCIPLES.

IN TWO PARTS.

BY WILLIAM MARTIN, F. L. S.
AUTHOR OF
"*Figures and Descriptions of Petrifactions collected in Derbyshire,*" *&c.*

MACCLESFIELD:
PRINTED BY J. WILSON.
SOLD BY THE AUTHOR, BUXTON; J. WHITE, FLEET-STREET, AND
LONGMAN, HURST, REES, AND ORME, LONDON.

1809.

PREFACE.

THE study of *extraneous fossils* is confessedly useful to the *Geologist*—it enables him to distinguish the relative ages of the various strata, which compose the surface of our globe; and to explain, in some degree, the processes of nature, in the formation of the mineral world—To the *Botanist* and *Zoologist*, an investigation, which leads to the knowledge of organic forms no longer found in a recent state, must always prove interesting—And the causes, that have operated to produce the distinctions existing between plants and animals of the present day, and those of former unknown ages, offer, to every contemplative mind, an inexhaustable source of rational enquiry.

In an age, therefore, like ours, when Natural History in general is cultivated with so much ardour, and introductory helps to its scientific attainment are daily increasing, I esteem it somewhat strange, that an elementary treatise, on the subject of *extraneous fossils,* should hitherto be wanting—That is, a treatise containing a regular exposition of *facts* and *principles,* on which the study may be conducted, agreeably to the relation it holds with other branches of natural knowledge.—The present work is an humble attempt to supply this deficiency.

It remains for me to offer a few remarks on the origin and progress of this design. When I first applied my attention to the collecting and describing of those subjects, belonging to the fossil kingdom, which are usually denominated *extraneous,* (*a*) I expected to find, in mineralogical or other works, some generally received principles, by which I might direct my researches—but in vain—no such principles have as yet been acknowledged. On the contrary, it is even undetermined by authors, what fossils properly come within the pale of this study, and what do not. Hence, some exclude all animal and vege-

---

(*a*) I employ the terms *native* and *extraneous fossils* as those in general use; but by no means contend for the propriety of their application—Relics and Minerals (*Reliquia et Mineræ*) are the terms under which I propose to divide the fossil kingdom. V. p. 3.

tal remains, that have not acquired a stony or other mineral character: (*b*) while others admit every fossil possessing the form of a plant or animal, although such form be merely imitative; that is, not derived from the body it accidentally represents. (*c*)

I was early induced to turn from such a contrariety of opinion, and seek for the principles, on which a knowledge of *organic remains* might be founded, in a diligent investigation of the bodies themselves: carefully noting every phenomenon that either established or opposed those ideas on this subject, which reading had given me; and, in conclusion, strictly observing to use nothing definitively as a principle in the study, till repeated applications had proved the propriety of its adoption. With such end in view, it will readily be conceived, that many speculative notions have been abandoned, which, at

---

(*b*) V. Gmel. Syst. Nat. &c.

(*c*) V. Justi, Vogel, Linnæus, &c.

In a late most ingenious work, we find every mineral considered as an *extraneous*, or (as it is there called) a *secondary* fossil, whose origin can be traced up to organized matter; although the form and structure of such matter be lost in a natural resolution of its constituent particles. V. Parkinson's "Organic Remains."

the commencement of my undertaking, appeared plausible and consistent (*d*). On this head, however, it is unnecessary to trouble the reader. I shall, therefore, merely give, in this place, a general sketch of those positions, which the present work receives as permanent ones; and on which, it is concluded, the study of *extraneous fossils* or *reliquia* must ultimately be fixed.

1. *All natural bodies without life, found on or beneath the surface of the earth, and which are not susceptible of putrefaction, belong to the fossil kingdom—Such bodies are either Reliquia or Minerals.*

In the definition of fossils usually given, they are stated to be "bodies destitute of an *organic structure.*"—This definition will not apply in many instances; for, though all fossils may be said to be *unorganized,* according to the common acceptation of the term, they certainly are not all destitute of the structure which distinguishes an organized body. This being admitted, however, it follows, that some line must be drawn, between animal and vegetal

---

(*d*) V. Tables of an Arrangement of Extraneous Fossils published in the first number of "Derbyshire Petrifactions." 1793.

matter recently buried in the earth, and that which has acquired a genuine fossil character—Such line will depend, perhaps, on *putrefaction*, to which even organic substances, after becoming legal *denizens* of the fossil world, are evidently no longer subject. V. p. 2. Note.

2. *An organic structure* (e) *immediately or derivatively that of a plant or animal, is the essence of an extraneous fossil or reliquium—By this alone is it characterized, or distinguished from a mineral.*

If these premises be not admitted, I do not see the ground on which the separation of *reliquia* from *mineral* bodies can take place. The *origin* of a fossil cannot alone furnish the distinction sought for, as this, in numerous instances, still remains disputable—and, on the other hand, there are substances, which universal consent ranks with *native* fossils or *minerals*, that undoubtedly originate from animal and vegetal matter. It will perhaps, however, not only be urged, that the proposed principle is insufficient for the purpose of division; but, also, that *extraneous forms* (as the modern school of mineralogy calls the structure of petrifactions, &c.) are not to be considered as independent of their constituent substances, but must be studied as mere modifications in the external characters of a mineral. Yet it is evident, that if *extraneous forms* are to be attended to at all, it *is* the *form*, and not the *material* in which it occurs, that is the primary object of investigation; and this, in my humble opinion, lays the foundation of a study, separate or distinct in its character from that of mineralogy. Indeed, with all due deference to the authority of Werner and his disciples, I think it may be justly questioned, if the *extraneous form* ought to be numbered among the external attributes of a mineral substance—At least, it is not an *essential one* (*f*), and of course can never,

---

(e) By the term *structure*, is here to be understood not only the internal fabric, but also the external figure of the fossil.

The structure of a fossil is either *organic* or *inorganic*. The *inorganic* is that which arises from a mere aggregation or juxtoposition of particles—this is called the *native* structure of a fossil, as originating in the fossil kingdom.—The *organic* is mediately or immediately that of a plant or animal—this is called the *extraneous* structure, as originating from bodies not belonging to the fossil kingdom.

(*f*) That only can be called an *essential* attribute, in any substance or species of matter, of which it cannot be deprived, with propriety, make a part in the *specific discrimination* of an *earth, metal,* &c. It is true, according to the positions with which we set out, an *extraneous fossil exists only in form:* take away such form, or consider the fossil to be independent of such form, and it becomes identical with mineral matter—But still, to describe the organic structure, as characteristic among the external appearances of a given mineral, is nearly the same, as to consider, in a plant or animal, the accidental variations of figure, received by impression (*g*) from some external body, as distinctive, and add them to the character and description of the species.

It is proper in this place to remark, that the principles now assumed will necessarily bring under the study of extraneous fossils some few bodies,

---

without destroying its identity—Such is the *inorganic* structure in minerals; for if we destroy one or more modifications of this form, some other will remain, as long as the matter itself exists—But we may obliterate every vestige of the *organic* structure in a fossil, and the matter remain the same.—This is, therefore, an *accidental* or *adventitious* form in fossil matter, if we consider such matter as a mineral species.

(*g*) Corals, shells, and funguses, are sometimes impressed with the form of the bodies to which they happen to adhere.

which modern Authors rank with minerals—Bovey-coal, woodstone, and wood-opal, for instance (*h*). —At the same time, it will exclude common coal, amber, and other bitumens, that no longer exhibit the structure of the animal or vegetal matter, from which they originate.

The *Graptolithi* of Linnæus and others (*Petrificata ficta*) containing *Dendritæ, Landskip-marbles,* &c. are not, on any principle, to be admitted among *extraneous fossils.*

3. *It is the organic form alone on which the arrangement of reliquia must be founded.*

(*h*) This only when their structure is primarily considered—their substance, if it prove to be distinct from other known species of mineral matter, must still be enumerated with minerals.

Werner considers the matter of woodstone as a subspecies of hornestone or chert—that of bituminous wood or Bovey coal, as a species of brown coal—and that of wood-opal, as a subspecies of opal. In each instance, however, the matter is characterized as differing from the primary species only in its vegetal texture. Consequently, according to the principle above advanced, it does *not* constitute a *mineral species distinct* from every other; but only a *substance* already determined, forming the material of an *extraneous fossil.*

Every system of natural bodies should assume, for its basis, but one principle; and this should be drawn from the most essential characteristics of the bodies under arrangement. Hence, *form* is pointed out as furnishing the only genuine principle, on which the classification of *reliquia* can be established. V. p. 182. also p. 199, Note.

It may be here objected, that I have not myself adhered to the principle now proposed; as both the *prototype*, or *original body*, and the *soil* of the *reliquium* are brought forwards to characterize the divisions of the *system*, given at the end of this work. But, with respect to the *prototype*, it is sufficiently apparent, that this is only to be determined according to the *form of* the *extraneous fossil;* consequently, in this instance, the principle of arrangement proposed is strictly followed up: and, in regard to the *soil*, I have to remark, that it is never stated, except as a secondary and factitious character—a mere geological help to discriminate a division, not a genuine distinction.

4. *The primary divisions of the arrangement (orders, genera, &c.) should agree with such natural divisions of plants and animals, as are determinable by the form of the fossil subjects.*

On this it is useless to offer any remarks, as the principle will be found sufficiently detailed in the body of the work.

5. *The specific differences in reliquia depend on the specific differences of form in the original bodies—One species of plant or animal can give but one real or genuine species of extraneous fossil.*

The present positions naturally result from those before advanced—For, if the *essence* of the *reliquium* be an *organic form*, its other affections, arising from *substance*, *mode*, and *soil*, are accidental, and cannot be used as *specific distinctions*, which must always depend on something essential to the body, we wish to discriminate. *Form*, therefore, must furnish the *specific differences of reliquia*; and it follows, that there will be as many genuine species of *reliquia*, as there are genuine specific forms in the animal and vegetal *prototypes*; and, that the number of fossil species are not increased by a separation of parts, or other accidental circumstances to which the original bodies may have been subjected, during the translation of their forms into the fossil kingdom.

I am fully aware of the impediments, that will be thought to oppose the general application of the principle now promulgated; but, the necessity of fixing the determination of *species*, on a certain and permanent basis, outweighs every other consideration. Indeed, the difficulty, that will attend the use of the proposed rule, must chiefly arise from our imperfect knowledge of *reliquiæ*; which, in certain instances, prevents the reduction of detached parts into individual *species*. This difficulty, however, will grow less, as our knowledge of these subjects increases;—and to meet the present state of the study, I think it will be sufficient to adopt, for a time, what I have denominated *temporary species*. V. p. 194. &c.

It will not here, perhaps, be foreign to the subject, to remark, that in Botany and Zoology what constitutes a *species* has long been fixed and acknowledged; while in Mineralogy, it seems undecided if *species* even exist! In the determination of minerals, neither the *integral molecule* (*i*) assumed by Haüy and Dolomieu, nor the *union of external characters and internal composition*, proposed by Werner, for the construction of *species*, has been uni-

---

(*i*) Doubtless, the nearest approximation towards the establishment of a *natural* principle, in the determination of the mineralogical species, that has yet been made.

versally admitted, and the want of such a generally received principle is daily experienced by the practical Mineralogist. In the study of *extraneous fossils*, also, no determinate principle for the division into *species*, has been hitherto established.—None, indeed, till now proposed (*k*). Hence, in every system of *reliquia* that has yet appeared, the species are without order and consistency; formed according to the caprice or convenience of the writer; and characterized by every possible affection, of which these bodies are susceptible.

6. *Specific distinctions of reliquia being founded only on the organic form, it follows, that their geological and mineralogical affections, with their modal diversities* (v. p. 72.) &c. *merely characterize specimens.*

For the application of this principle the reader is referred to p. 197.

7. *The specific descriptions of reliquia are to be given according to the principles of Botany and*

(*k*) Cronsted and Bergman's arrangement of extraneous fossils can scarcely be said to have contained a proposal for the establishment of species, as the specific distinctions of the mineral substances, on which the arrangement was founded, still remained undetermined.

Zoology—Those of the specimens, according to the principles of Mineralogy and Geology.

It is particularly necessary to distinguish, by description, the *essential* form of the *reliquium* from the *accidental*—that is, the form of the original body, from that which has arisen in the fossil from the mode of mineralization, the constituent substance, and the soil of the specimen.—Hence, the use of the present principle will be sufficiently apparent (*l*).

8. *The nomenclature of reliquia should always manifest the extent of our knowledge with respect to the original bodies.*

On this principle, if we know the original recent *species*, the name of the *reliquium* must distinguish it.—If only the *kind* or *genus*, still that kind must be nominally pointed out in the fossil. In *temporary species* of *reliquia* (v. p. 194.) the part

---

(*l*) It will be advisable for the student never to make his descriptions from single examples, however perfect they may appear to be.—In many instances, it is only by collating a number of specimens, that we are able to acquire that knowledge of a species, which is sufficient for the purpose of its discrimination.

of the animal or plant giving the form should also be shewn by the name; as this is frequently the most material, and sometimes the only information, we are able to give of the original body.

The principle of nomenclature now assumed, will, I think, properly remove from the study all those names, which have been given to *extraneous fossils* without any reference to their origin; as *Nummus brattensburgensis, Bufonius, Stone Lily*, &c.—except when these names are used in conjunction with legitimate appellations; or, no longer conveying their original meaning, have become fixed and appropriate designations of tribes or divisions; as is the case with the terms *Glossopetra, Bufonitæ*, &c. &c.

On the above eight fundamental principles, I conceive, the study of reliquia may be scientifically conducted.

Judging from the foregoing statement only, the reader, perhaps, will object that our premises must lead the student's attention wholly to the *organic* form of *reliquia*, and necessarily hinder him from paying a due regard to certain relations, which ought to constitute a distinguished part of his study. An examination of the work itself, I trust, will prove this objection to be groundless. I have, as far as the extent of this design would admit, fully endeavoured to point out the connection, which subsists between the objects of our present investigation and those, which lawfully come within the province of the Geologist and Mineralogist. And, indeed, I wish forcibly to impress it on the mind of the student, that, however extensive or well-arranged his cabinet, the knowledge acquired *there* of extraneous fossils must ever be defective, unless joined to the study of these bodies in their native repositories. At the same time, it has been my aim to draw a determinable line between the direct and collateral parts of the science; or (in other words) between those circumstances which are essential to the arrangement and *specific* discrimination of *reliquia*, and those which form their mineralogical and geological distinctions.

In the division of this work, I have given the facts and inferences, forming the basis of the study, in distinct propositions: to these are added such observations, as were thought immediately necessary for illustration: the more extraneous remarks, with references to authors, lists of zoological terms, &c. will be found at the bottom of the page, in the form of notes.

An attempt like this, to establish the elements of a study, the objects of which form, as it were, the common boundary between the organic and inorganic kingdoms of nature, has unavoidably led to details, that the already-informed naturalist may, perhaps, think unnecessary, and sometimes even impertinent—I here particularly allude to the definitions of the classes and orders of animals and plants, given at page 77—86.—the observations on mineral substances, p. 136—152.—and the characters of such *families*, in the systematic arrangement of *reliquia*, as are immediately founded on the known generic distinctions of the recent subjects.—To the mere student, however, these explications are not unimportant:—they will serve as first steps to the acquirement of that knowledge, without which his proficience in the study of extraneous fossils can be but trifling.

Technical language must of course alter, in some degree, with the changes that progressively take place in the science, to which it belongs. The present treatise adds a very few terms to those already used by naturalists: it is my wish, they may not be found either useless or anomalous.

It was my intention to have given, at the end of the work, a list of authors who have written on extraneous fossils; but, as such list has previously been drawn up by others (*m*) its omission here can be of little moment.

The reader is now in possession of my plan—It must be considered, merely, as an attempt to give the principles of a study yet in its infancy—A study however, hourly rising into notice, and which the best Mineralogists of the *present day* (*n*) have pointed out to the attention of all, who wish for the advancement of general knowledge.

In respect to the execution of this design there is little to offer. At a distance from extensive collections and valuable libraries, those necessary helps to the naturalist when writing—my time almost wholly taken up with the duties of my profession—and debarred, by local situation, from that personal intercourse with the scientific, which might so mate-

---

(*m*) V. Townson. Phil. Min.—Jameson, Miner. Dumfries.—Parkinson. Organ. Remains. &c.

(*n*) Compare the observations of Werner, Kirwan, Jameson, Cuvier, &c. on the subject of extraneous fossils, with the illiberal reflections cast on the study by the late M. Magellan, in his edition of Constadt's Miner.

rially have aided me in my pursuit (*o*)—this work is truly the production of one who has possessed few advantages for its completion—none, indeed, except those which have arisen from a long residence in a mining county (*p*) where the objects of the study abound, and have been constantly examined under their most interesting relations—Hence I beg leave to add, that a large portion of the facts advanced in this treatise, has been repeatedly confirmed by my own observations.—These facts, I am aware, are often rudely explained, and sometimes inartificially put together: but, I trust, the errors and deficiencies of the work will not be found so numerous, as to prevent its being considered a proper collection of *data*, for the student to proceed on. Hereafter, perhaps, some one with leisure and abilities equal to the task may condescend to fill up these "*Outlines;*" or, sketching others with a happier hand, give to the world a complete "*Philosophia Reliquiorum.*"

(*o*) I should be wanting in gratitude, however, if I did not here acknowledge the obligations I am under to my friend Dr. Hull, of Manchester, for some valuable hints on the nomenclature of petrifactions.

(*p*) Derbyshire.

ADDENDA.

Page 6. Add to Note ††—It should be observed, that the *complanation* or *flattening* of the reliquium only takes place when its position, in respect to its length, is parallel with that of the laminæ of the inclosing substance. If the fossil be an elongated or lengthened body, as the stem of a plant, &c. and its direction perpendicular, or nearly so, to the slaty structure of the surrounding stone, it always retains the original bulk of the prototype. I have observed this phenomenon repeatedly, in the shales and gritstones of Derbyshire, Lancashire, and Cheshire. Vide, also, Jameson's Elem. of Geogn. p. 181.

In Note †, it is observed that rock-salt sometimes occurs in strata abounding in extraneous fossils.—This is asserted on various authorities. V. Kirwan G. Ess. p. 373. In England, however, I believe neither marine nor any other kind of organic remains have been found in the strata which accompany rock-salt—At least, so I judge from my own observations, and all the information I have been able to obtain from others on the subject, during a residence of some months at Northwich, Cheshire.

Page 25. Add to Note on the Neptunian Theory—I have to regret my not receiving a copy of Professor Jameson's exposition of the Wernerian Geognosy till the present sheets were printed off. It would have enabled me to have avoided a few errors, I have been led into, from the view taken of the prevailing Neptunian system of Geology by others—the chief of these, however, are perhaps the following.

Prop. 9. Obs. "The diminution in the height of the water is accounted for, by supposing the ocean began to retire gradually into the internal cavities of the earth." The reader may suppose from this statement, that the Wernerian opinion on the subject is here alluded to; but this is not the case: Werner proves, by various phenomena, that a gradual diminution in the waters of the ocean *has* taken place, but offers no hypothesis in explanation of this fact.

Prop. 13. "The strata formed by these depositions" (constituting the *transition* rocks of Werner) "were chiefly of rubble-stone, sand-stones: some limestones, breccias, argillite, chert, and perhaps porphyries and sienite."—The only transition rocks enumerated by Professor Jameson are transition-limestone, transition-trap, grey-wacke, and flinty-slate; to which he afterwards adds transition-gypsum. These, I presume, are the only rocks *now* considered by Werner as belonging to the genuine transition class. Under grey-wacke are placed common grey-wacke (rubble-stone) and grey-wacke slate, sometimes confounded with clay-slate (argillite).—Professor Jameson himself has, however, considered argillite as a transition rock in some instances. V. Miner. vol. 1. p. 335. &c.

Prop. 16. Obs. "Hence Werner distinguishes them by the title of stratified rocks."—It should have been, perhaps, *floetz rocks*. The terms are, however, frequently used indiscriminately by pupils of the Wernerean school, though by no means synonymous.

Page 139. Add to the observation, "we have not ourselves found any variety of *baroselenite* under an organic form."—Gmelin, indeed, expressly states that *terræ ponderosæ*, in which he includes the species just noticed, are never found in an organic form. V. Syst. Nat. T. 111. p. 63.

Page 140. Add †† to the words "vegetal petrifactions" (line 12) as a reference to the following Note—†† The term *vegetable*, as generally used in the present study, is certainly incorrect.—A *vegetable* petrifaction or fossil literally implies a petrifaction or fossil capable of vegetation! We should not, however, have ventured to have proposed a change in a term so long established, had we not observed, while these sheets were in the printer's hands, such change already adopted, on principles, in our humble opinion, perfectly philological. Vide Desmond' Transl. of Fourcroy's Chem. Phil. Preface, p. xviii.

Page 168. Add to the definition of the TRACT (A. 143) the following—Obs. The *tract* of a soil, or its visible extent at the surface, may be formed by the *surface* of the upper stratum *only*, or by the extremities of *several* strata, when they have a considerable deviation from the horizontal position. The extremities of such strata are called their *outgoings* by the Wernerian school.

—— —. Add to the definition of A PARTIAL TRACT (b. 151) after the words "of a different kind,"—or formation, and generally of a larger extent than the one included; under which the strata constituting the surrounding tract are observed to dip.

EMENDANDA.

PART I.

⁂ *Engagements, which the author could neither postpone nor avoid, have prevented his attending regularly to the correction of the press: the reader's indulgence is, therefore, requested for the following errata.*

Page 2, line 5 from bottom, for agreeable, r. agreeably. Del. comma after fossil.
4, 11 from bottom, for Naturalist, r. Naturalists.
8, 8 from bottom, (and *passim*) for vegetable r. vegetal. Vide addenda.
10, 8, for inflamable, r. inflammable.
13, 3 from bottom, for retain, r. retains.
18, 8 for deposited, r. deposit.
21, 5, for primative, r. primitive.
22, 12 from bottom, for subteraneous, r. subterraneous.
24, 17, for stratafied, r. stratified.
29, last, for agreeable, r. agreeably.
31, 11, for regular, r. regularly.
38, 1, for loged, r, lodged.
—, 11 from bottom, for agreeable, r. agreeably.
39, 2 from bottom, prefix A. as a divisional letter to 1. CONSERVATION.
40, 10, prefix a. as a divisional letter to 2. PRIVATION.
42, 2 and 3 transpose.
46, 5, prefix b. as a divisional letter to 3. CONVERSION.
48, 18, for *corbonate*, r. *carbonate*. Line 2 from bott. for *time*, r. lime.
52, 5 from bottom, del. of.
64, 4 from bottom, for testaceous, r. testal; and *passim*, when the term testaceous is used without reference to the *substance* of the *reliquium*. V. testal, p. 96 and testaceous, p. 153.
72, 3 from bottom, for *Reliquia*, r. Conservata.

73, 4 from bottom, for Vegetable (*Vegetabile*) r. Vegetal (*Vegetale*), and *passim*. V. addenda.
95, 5, subjecs, r. subjects.
104, 14, for *spongiæ*, r. spongia.
127 14 from bottom, for "the term *secundus—unilateralis*," &c. r. the term *secundus*. The term *unilateralis* may still be retained, &c.
139, 11 from bottom, for *stirated*, r. *striated*.
146, 13, for zink, r. zinc.
149, 3, for complets, r. complete.
150, 14, for Zink, r. Zinc.
157, 10, for "after these *sienite, siliceous, schistus*, &c. r. "after these *argillaceous schistus, siliceous schistus, sienite*," *&c.*
—— 11, for *porphyries*, r. porphyries.
—— 14, for *sandstone, rubblestone*, r. *sandstone? rubblestone?*
159, 12, for *porphory*, r. *porphyry*.
162, 11, for "rarely appear in hills, but generally," &c. r. rarely appear in hills (except, perhaps, when basalt occurs as a modern soil), but generally," &c.
—— 18, for "*chalk* and *sandstone*," r. "*chalk, sandstone, basalt?* and *wacken?*"
165, 3, from bottom, for shatter, r. shattered.
168, 13, del. in.
112, 16, for "never parallel, r. "rarely parallel."
174, 13 from bottom, for desicàtion, r. desiccation.
175, 1, for Common, r. Rare.
188, 13 from bottom, for *succedanea*, r. succedaneæ.
190, 10, for spceies, r. species.
196, 10, from bottom, for depend, r. depends.
197, 16, for *Model*, r. *Modal*.
199, 9, from bottom, for animal, r. animals.
204, 16, for Erismalolitus, r. Erismatolithus.
210, 12, for medulâ, r. medullâ.
——, 22, for medulâ, r. medullâ.—For *Pentacrinus*, r. *Pentacrini*.
213, 18, for sæpé, r. sæpè.
214, 2, for punctatis, r. punctata.
——, 20, for margœ, r. margæ.
215, 10, postissìmùm, r. potissimûm.
——, 21, for Canda, r. Cauda.
——, 22, abdominisqure, r. abdominisque.
213, 7, del. period after *Formarum*.
——, 20, for noenuncquam, r. nonnunquam.
219, 18, for stripe, r. stirpe.
——, 23, for calcareous, r. calcareus.
220, 10, for *Relequium*, r. *Reliquium*.
——, 17, for statum, r. stratum.

⁂ *For the errata of second part, v. p. 222,*

TABLE

OF

CONTENTS.

PART THE FIRST.

ELEMENTARY INTRODUCTION to the *Study* of Extraneous Fossils . . . . page 1–221

§. I. PRELIMINARY.

Natural Bodies

A. Animals . . .
B. Vegetables . .
C. Fossils . . . } definition of — 2

Fossils

A. Native Fossils or Minerals
B. Extraneous Fossils or Reliquia . . . } definition of — 3

Notes to Sect. I.

Bergman's definition of *organic* and *inorganic* bodies—Extraneous fossils to be considered unorganized bodies, though they do not agree with Bergman's definition. p. 1.—Fossils scarcely to be distinguished from Animals or Vegetables by a single character.—The only *simple* note of distinction between Fossils and Animals or Vegetables depends on *putrefaction*. p. 2.

§. II. RELICS or Extraneous Fossils.

Their Kinds.
A. Conservata . . definition of page 4
B. Petrificata . .
Their Phenomena.
A. General . . . — 5–8
B. Peculiar to Petrifactions stated — 8–12
C. ——— to Conservata — 12–14
Their Origin.
A. Origin of Conservata stated — 14
B. ——— of Petrificata — 15
Their Introduction into the Mineral Kingdom, — 16
A. Periods of Introduction.
First period . . — 20
Second — . . stated — 24
Third — . . — 26
B. Agents of Introduction.
The Ocean . . their proba- — 27
Ancient Lakes and Seas ble agency in — 32
Rivers and modern Lakes the introduc. of Extr. Foss. — 34
Local inundations . into the Min. — 35
The general Deluge . Kingd. stated. — 37

PRINCIPAL NOTES to Sect. II.

Conservata generally considered as petrifactions—The latter term used only in a limited sense in the present work—the distinction between conservata and petrificata does not afford a principle of arrangement. p. 4. Compressed or flattened extraneous fossils common to all laminated strata. p. 6.—Vegetal and marine animal reliquia sometimes occur in the same strata. p. 7.—Certain petrifactions most common in particular substances. p. 9.—Some remains of the substance of the original body to be traced in most petrifactions. p. 11.—Conservata sometimes found in ancient strata. p. 12.—Conservata found in veins. p. 14.—Various opinions on the origin of extraneous fossils. p. 15.—Various suppositions respecting the introduction of extraneous fossils into the mineral kingdom—Extraneous fossils introduced at different periods and under various circumstances—Explanation of the mode, in which organic bodies have become subjects of the fossil kingdom, intimately connected with *geology*—Outlines of the *Wernerian system of geology* stated. p. 16—25.—Inclosure of fish in mineral strata accounted for by *Raspe* and *Graydon*. p. 29.—Vegetal remains, mixed with those of the sea, not indicative of the agency of the *deluge*. p. 29.—Extensive beds of sand, &c. connected with a *river* have generally originated from former *lakes*, with which the river has been united. p. 35.—Depositions of organic bodies, unequivocally demonstrative of a general flood, have scarcely yet occurred. p. 36—38.—Introduction of extraneous fossils into veins. p. 38.

§. III. DISTINCTIVE CHARACTERS of the Reliquia.—dependant on their *Mode, Form, Prototype, Substance,* and *Soil.* . . . page 37–180

Modes . . . . definition of, — 39
A. Conservation of organic remains under — 39
  Privation . . . . stated — 40
  Conversion . . . stated — 46
  Impregnation . . stated — 50
B. Substitution of *mineral* for *organic* matter; or the formation of petrifactions, under
  Redintegration . . stated — 52
  Intromission . . stated — 55
  Transmutation . . stated — 61
Terms distinctive of Reliquia according to the *Mode*. . . . . . . — 66

Forms or Structure. . . . . — 70
A. Essential form of reliquia
  External . . . . what . — 71
  Internal . . . . what . — 71

B Accidental form

Mineral . . . defined page 71
Modal . . . defined — 72
Conditional . . . defined — 73
Terms ditinctive of Reliquia according to the *Form.* . . . . — 73

Prototypes . . . . — 75

a. *Their kinds.*

A. Animal prototypes.

Mammalia . . . definition of — 77
Birds . . . . definition of — 78
Amphibia . . . . definition of — —
Fish . . . . . definition of — 79
Insects . . . . definition of — 80
Worms . . . definition of — 81

B. Vegetal—

Funguses . . . . definition of — 82
Flags . . . . definition of — 83
Mosses . . . . definition of — 84
Fernes . . . . definition of — —
Grasses . . . definition of — 85
Palms . . . . definition of — —
Plants . . . definition of — —

b. *Their parts.*

A. Animal parts.

Innate . . . what — 86
Fabricated . . . what — 87

B. Vegetal—

Substantial . . . what — 89
External . . . what — 90

Terms distinguishing the Reliquium according to its *Prototype* . . . . . . page 91

Substances . . . . — 138
A. Organic—what . . . . . . — 139
Earthy . . . . } stated { — —
Inflammable . . } { — 136
B. Mineral—what . . . . — 136
Earthy . . . } enumerated { — 136
Inflammable . . } { — 144
Metallic . . . } { — 146
Saline . . . . } { — 151
Terms distinctive of Reliquia according to their *Substance* . . . . — 152

Soils . . . . — 155
a. Their relative age.
A. Primary soils . . } what { — 156
B. Secondary — . . } { — 157
Most ancient, & anc. s.s. } what { — 158
Less ancient — . . } { — 159
Modern — . . . . } { — 162
Very Modern — . . } { — 163
b. Their structure.
A. Continuous soils . . } what { — 165
B. Stratified — . . } { — 166
c. Their materials.
A. Calcareous soils
Cretaceous — . . } what . — 167
Marmorean — . . }
Marlaceous — . . }

B. Argillaceous soils
Schistose — . . } what page 167
Arenaceo-argillaceous }
C. Siliceous soils
Quartzy . . . }
Arenaceous . . } what . — 167
Sabulous . . . }

c. Particular products.

A. Carboniferous soils . } what . — 168
B. Ferriferous — . . }

d. Parts.

A. The Tract . . . what . — 168
General . . . } defined . — —
Partial . . . }
B. The Seat . . . . what . — 695
Aqueous . . . } what { — —
Mineral . . . . } { — 170
Its structure and materials stated, . — 170–175
C. The Matrix . . . what . — 175

* Formation.

Genuine Matrix . }
Spurious — . . } what . — 176
Continued — . . }
Distinct — . . }

** Substance.

Earthy Matrix . . }
Inflammable — . . } . . . — 178
Metallic — . . . }

*** Parts.

Surface of the matrix }
Impression — — . } what . page 178

Terms distinguishing the Reliquium according to its connection with the *Soil* . . . — 179

Principal Notes to Sect. III.

Composition of recent bones—Professor Playfair's observations on fossil bones—Carcase of a Rhinoceros found fossil. p. 41—43.—Extraneous bodies inclosed in amber—Amber common in Prussia—Amber though of vegetal origin, not to be considered an extraneous fossil—Shells &c. found nearly in the recent state, particularly in Hampshire. p. 43—44.—Vegetal bodies frequently found fossil in an unmineralized state. p. 44.—Composition of shells, corals, and the crusts of Echini stated according to Mr. Hatchett's observations. p. 47—48.—Vegetal matter in the state of *charcoal* frequent in the mineral kingdom. p. 49.—Process of the change of vegetal bodies into *bitumen, carbon,* and *pit-coal.* p. 49.—Connection between the processes of *conservation* and those of *petrifaction.* p. 51.—*Nuclei,* what—not to be considered a mode of petrifaction. p. 54.—*Intromission* can only take place under particular circumstances—Theory of the change produced by *intromission.*—Mr. Parkinson's hypothesis of the petrifaction of wood examined. p. 55—60—Distinction between petrifactions by *transmutation* and conservata by *conversion* pointed out. p. 61.—Mr. Parkinson's excellent explanation of the mode in which some vegetal petrifactions are produced. p. 62.—Petrified leaves improperly considered as mere impression—not always the production of *transmutation.* p. 63.—Distinctions of *nuclei.* p. 64.—Professor Playfair's remark on the texture of petrified shells, &c. p. 64—Explanation of the mode in which the *spurious nuclei* of vegetal reliquia are formed. p. 69.—Linnean enumeration of the *modes* of extraneous fossils. p. 70.—The term *complanated* substituted for *compressed*—reason why—the *complanation* of reliquia, on what dependant. p. 74.—*Half-shaped* Petrifaction, how formed. p. 75.—Observations of M. Cuvier on the fossils remains of the *elephant, rhinoceros,* and other *mammalia.* p. 77.—The supposed fossil *crocodile* in Derbyshire, probably an *orthoceratites.* p. 79.—Winged insects very rare in the fossil state. p. 80.—Fossil corals sometimes mistaken for petrified *funguses.* p. 83.—Petrified wood in New South Wales. p. 90.—Terms used in descriptions of *Echini* explained. p. 93.—Terms not used by Linnæus in the sense in which we have employed them, explained. p. 95—Terms, testaceological, explained. p. 97.—Terms used in descriptions of *fulciments,* i. e. *corals,*

corallines, and *sponges*, explained. p. 103—134.—Rottenstone in Derbyshire, produced by the disintegration of *black limestone*. p. 140.—Petrifactions common in chert. p. 142.—Woodstone, how distinguished by authors. p. 143.—Petrifactions in jasper, different opinions on. p. 144.—Petrifactions, *agate*, what. p. 144.—Lehman's distinction of rocks best suited to the present study. p. 156.—Distinction of transition rocks according to Werner. p. 158.—Alluvial rocks, observation on. p. 161.—*Granite* masses perhaps only detached parts of an immense stratum. p. 165.—Petrified wood found in water, observation on. p. 169.—Distinction between *bed* and *stratum* according to the Wernerian school. p. 170.—*Dip*, *crop*, *stretch*, &c. of a stratum, what. p. 171.—*Veins*, division of, into *rake* and *pipe*. p. 172.—Reliquia of veins sometimes the same as those in the surrounding rocks. p. 173.—*Impression* not a mode of petrifaction. p. 178.

§. IV. GEOGRAPHIC SITUATION of Reliquia.
Particular . . } what . page 181
General . . . }

§. V. PRINCIPLES OF ARRANGEMENT. — 182–198
On what hitherto founded—An Arrangement founded on that of the *recent subjects*, most eligible. — 183
Class, Order, Genus, what . . . — 114
Natural Genera—Artificial Genera, what . — 185
Enumeration of Genera . . . . . — 186
Families, permanent, what . . . . — 187
———, temporary, — . . . . . . — 188
Species, on what founded . . . . — 188
Species, permanent, what . . . . . — 189
Enumeration of the parts on which permanent species are to be founded . . . . . — 189–194
Species, temporary, what . . . . . — 194
Enumeration of the parts on which temporary species are to be founded . . . . . — 194–195
Species, temporary, not to be unnecessarily multiplied . . . . — 195

Varieties, what . . . . . . page 196
Specimens, what . . . . . . — 196
Enumeration of the various kinds of specimens — 197

Principal Notes to Sect. V.

Orders arbitrary divisions. p. 184.—Natural and artificial divisions, what. p. 184.—Species the fundamental parts of every system—the principle, *that one species of plant or animal can form but one genuine species of reliquium,* not before adopted in any system of extraneous fossils. p. 188.—Reasons for fixing on the parts enumerated, as the foundation of permanent species. p. 190—193.

§. VI. PRINCIPLES OF NOMENCLATURE. — 998-205
Name of the *class* . . . . . . — 198
Names of the *order* . . . . . . — 200
—— of the *genera* . . . . . — 200
—— of the *families* . . . . — 202
—— of the *species* . . . . — 202
Trivial name, what—from what to be formed, — 203

Principal Notes to Sect. VI.

Petrifactions not to be separated from *conservata* in a systematic arrangement of *reliquia.* p. 199.—Insertion of the *family* name, between that of the *genus* and *species,* when the original is unknown, recommended. p. 203. Reason for using *two words* as the trivial name of a *reliquium,* of which the original is known. p. 204.

§. VII. DELINEATIONS of Reliquia . — 205
Elementary parts of the delineation
Specific character, what; mode of its construction 206
The parts of the delineation appendant to the specific character enumerated . . — 208
Description, what . . . . . — 210
The parts of the delineation appendant to the the description . . . . . — 212
Order of the delineation . . . . . — 212

Delineationis Exempla.

Ichthyolithus *trigonus*, . . page 214
——— *sagittidens*, . . — 216
Conchyliolithus *Muricis antiqui*, . — 218
Erismatolithus *Parkinsoni*, . . — 219
Phytolithus *Sowerbii*, . . — 220

Notes under Sect. VII.

Remarks on the genus Isis.—A new genus proposed.—Encrinites, what, p. 207—211.—Observation on the substance of the fossil fish of Monte Bolca, p. 216.

PART THE SECOND.

SYSTEMA RELIQUIORUM . . . — 222
§. I. Regnum Fossile, ... — 225
§. II. Reliquia, ... — 226
§. III. Reliquiorum Ordines, . . — 226
§. IV. Genera Reliquiorum, . . — —
Synopsis Generum, . . . — 227
Characteres Generum, . . . — 228
§. V. Familiæ Reliquiorum, . . — 230

OUTLINES.

PART THE FIRST.

ELEMENTARY INTRODUCTION
TO
THE STUDY
OF
EXTRANEOUS FOSSILS;
EXHIBITING
THEIR DISTINCTIVE CHARACTERS,
GEOLOGICAL RELATIONS,
NOMENCLATURE,
&c.

CONSPECTUS.

§. I. Preliminary.
§. II. Relics.
§. III. Distinctive Characters.
§. IV. Geographic Situation.
§. V. Principles of Arrangement.
§. VI. Nomenclature.
§. VII. Delineations.

ELEMENTARY INTRODUCTION, &c.

§. I.

PRELIMINARY.

Natural Bodies.

THE natural bodies, which constitute our globe, are either *organized* or *unorganized*: † the first division includes *animals* and *vegetables*, the latter *fossils*.

---

† *Corpora organica.* Hæc internorum vasorum congerie prædita sunt, qua e nutrimentis adsumptis moleculæ extrahuntur, præparantur, vehuntur et distribuuntur, incremento, sustentationi et propagationi inservientes. *Corpora anorganica.* Anorganica audiunt, quæ omni structura organica destituuntur, appositione particularum externa vi attractionis unice concrescentia. Berg. Med. de Syst. Foss. Nat. §. II. et IV. Extraneous fossils do not properly accord with Bergman's definition of *corpora anorganica,* though he himself considers them as such. Those bodies, however, though possessing an organic form, may, with propriety, be defined as unorganized, since that form is no longer instrumental to growth, motion, or the propagation of the species.

A. 1. **ANIMALS** are natural bodies, organized, living, and sentient.

B. 2. **VEGETABLES** are natural bodies, organized, and living, but not sentient.

C. 3. **FOSSILS** are natural bodies, unorganized, and neither living, nor sentient.††

---

†† The Linnean complex definitions of the animal, vegetable, and fossil kingdom, are frequently objected to; but none more simply correct, or applicable have been, or perhaps can be, produced. Indeed, it has been repeatedly remarked, that animals and vegetables are so closely allied, it is hardly possible to draw a line of separation between them; and we may add, that the limits of the fossil kingdom are scarely determinable by a *single* character; at least, not by any one founded on structure, chemical analysis, or the want of life or sensation. There are many fossil substances, for instance, which our systematic mineralogists rank even with native minerals, and which, when accurately examined, are found to possess the structure of organized bodies: such are the woodstones, Bovey coal, surturbrand, &c.—nor will chemical analysis, it is evident, in all cases, distinguish a mineral from an animal or vegetable body, as there are substances, chemically the same, which belong equally to the animal, vegetable, and mineral world. Again, the absence of life does not independently form a discriminative character, for were this the case, it follows, that animals and vegetables, when merely deprived of life, are to be classed as minerals! Perhaps the only simple note of distinction, between fossils and animal, or vegetable bodies, is that which *putrefaction* affords. And hence, agreeable to this view of the subject, all fossil, animal, or vegetable matter, when it has passed that process, or occurs preserved from its effects by means of some natural operation, is to be considered as belonging to the mineral kingdom, although an organic arrangement of its particles may remain.

Fossils.

THESE bodies are usually distinguished into *native* and *extraneous.*

A. 4. NATIVE FOSSILS, or MINERALS (*Fossilia nativa s. Mineræ*) are fossils destitute of an organic form: exhibiting such a structure only, as arises from the apposition of the particles, of which they are composed. Minerals arrange under 4 classes—*Earths, Inflammables, Metals,* and *Salts.*

B. 5. EXTRANEOUS FOSSILS, or RELICS (*Fossilia extranea s. Reliquia*) are fossils, which have the form or structure of animal or vegetable bodies.

§. II.

RELICS.

Kinds.

EXTRANEOUS fossils comprehend two *sorts* or *kinds* † of animal and vegetable relics—*Conservata* and *Petrificata.*

---

† Fossil plants and animals are found principally in two distinct or separate states: in one, the original, organic matter (at least in part) and its conformation are preserved; in the other, the structure or form of the original alone remains, the animal or vegetable

A. 1. *CONSERVATA* are the *remains* of *animals* (§. I. 1.) or *vegetables* (§. I. 2.) preserved by various operations of nature amongst *minerals*. (§. I. 4.)

B. 2. *PETRIFICATA* are *mineral bodies* (§. I. 4.) which have, mediately or immediately,†† received their form from *animals* (§. I. 4.) or *vegetables*. (§. I. 2.)

Phenomena.†††

The Phenomena attendant on the *reliquia* are either *general* or *peculiar*.

---

being displaced by a mineral substance. The distinction, between these two conditions or kinds of *reliquia*, should most carefully be attended to, as it will be found of peculiar importance in geological researches, to which a knowledge of these bodies immediately applies.

The *reliquia* have usually been considered, particularly by the German Naturalist, as *petrifications*. In the present work the term *petrification* is used only in its more proper and limited sense.

We have to observe, although they are thus primarily distinguished, that these two states or modes of extraneous fossils, by no means afford a ground for their classification or arrangement; this is to be founded on other principles. Vide pt. 2.

†† *Mediately*, when moulded in the hollow impression made in the matrix by the original body. *Immediately*, when moulded in the vacuities of the original body itself.

††† The object, which first claims attention in the study of Extraneous fossils, is the investigation of the *phenomena* attendant

A. 3. The *general phenomena* are such, as are *common* to both kinds of organic remains. These are the following.

a. Reliquia, or extraneous fossils, have been found in every quarter of the known world.

b. They are met with embodied in the hardest rocks and stones, as well as in the softer materials, of which the surface of the earth is composed—

c. They are not, however, equally common to all rocks and mineral substances—

d. Granite, sienite, gneiss, micaceous shistus, some *species* of *limestones,* &c., *never* contain organic remains. (v. §. III. Soil, &c.)

e. In *rubblestone, breccias, gypsum, trap,* &c., they very *rarely* occur—

f. Most *limestones, sandstones,* and *clay-strata, abound* with them.

g. The rocks, &c., in which *reliquia* are never found, constitute the highest mountains known.

h. Those which *rarely* hold, as well as those which *abound* with extraneous fossils, form also mountains, but of an height† generally inferior to the preceding.

---

on these bodies in their mineral beds; this leads to an inquiry into their *Origin,* and the *Time* and *Mode* of their introduction into the fossil kingdom.

† According to an observation of Mr. Kirwan's, no extraneous fossils are embodied in the stone of mountains higher than eight or nine thousand English feet above the present level of the sea. This is, however, disputed by many geologists.

i. The strata or masses of stone, &c., in which *reliquia* are never known to exist as *integrant parts*, but which, as just stated, constitute the most elevated mountains, are always found to *dip* towards, and at length *underlay* the strata, &c. forming the lower hills and plains, in which *reliquia do occur*.

k. Between strata abounding in extraneous fossils, beds of stone or other matter frequently interpose, which seldom or never contain organic remains in any situation.†

l. In strata with a slaty or laminated texture, extraneous fossils are always compressed or flattened,†† although the same species, in concomitant strata of substances not laminated, preserve the perfect bulk of their originals.

m. The parts of organized bodies most common in a fossil state, are those which are known longest to resist putrefaction and decay—i. e. wood and the leaves and stems of certain plants—shells, bones, corals, and other hard parts of animals.

n. Very tender and succulent bodies, whether animal or vegetable, are rarely found in a fossilized state.

---

† Thus strata of rock-salt and gypsum, which rarely hold extraneous fossils, sometimes alternate with clays and sandstones, abounding in those bodies—Our Derbyshire *toadstone*, in which the smallest trace of organic remains has never yet been discovered, runs between strata of limestone full of petrifactions.

†† This observation has usually been confined to petrifactions found in strata of common clay or other argillaceous substances, but is equally applicable to all extraneous fossils bedded in laminated stones, whether argillaceous or not.

o. Shells, and various marine *exuviæ* of the *vermes* class, without the intermixture of other organic remains, are most commonly found in the strata immediately reposing on, or following tracts of granite, gneiss, and the other rocks, in which extraneous fossils are never imbedded.

p. Strata containing the remains of *fish* and *marine shells,* &c. mixed sometimes, with the parts of *amphibious animals* and *plants*—or those in which *vegetables* only occur—generally succeed, or rest on the tracts, in which the *exuviæ* of *vermes* alone are found.

q. The remains of *land-animals,* particularly of the class *mammalia,* rarely occur in regular strata —When they do, the strata are usually superficial; overlaying, but never dipping under, beds of other formation.

r. Animal *reliquia,* particularly the marine, though not confined to, are most common in *calcareous* strata.

s. Vegetable *reliquia* frequently occupy independent *argillaceous* beds, especially those productive of coal.

t. But strata containing vegetable remains only, or vegetable remains mixed with fluviatile shells, &c. sometimes (though not often) alternate with strata, in which marine relics are found. †

---

† Coal-beds and their accompanying argillaceous strata, holding only vegetable remains, have, in some parts of England, been found

u. In strata holding *vegetable reliquia,* as well as in those in which the *animal* occur, the different species are *sometimes* confusedly mixed or blended together—But

v. It more frequently happens, that the different species are found in distinct or separate accumulations.

B. 4. The *phenomena peculiar* to petrifactions may thus be stated.

a. *Petrifactions* are generally confined to mountains, or other elevated situations, where the *more ancient* of the *secondary strata* are presented to our view. (v. §. III. Soil, &c.)

b. They are usually incorporated in the earths and stones, of which these strata consist,†† forming

---

separated by seams or very thin strata of calcareous stone, containing *echinitæ* and other marine productions———About a mile from Buxton, Derbyshire, on the right of the Macclesfield road, a coal-pit was opened some years back, in which we observed strata of shale and ironstone abounding in impressions of *anomitæ,* &c. although the interceding beds of coal and gritstone exhibited only vegetable petrefactions—these can only be considered as partial exceptions, however, to the more usual phenomenon of vegetable fossils and the remains of marine animals occurring in distinct tracts.

†† The most common exception to this remark, and to the foregoing one, under *a.*, occurs in petrified wood, or woodstone, (*Lythoxylon*) which is generally confined to water or modern alluvial tracts, and is mostly found in a loose or unconnected state.

as it were, a part in the original fabric of the globe. †

c. No particular petrifaction is confined *wholly* to one kind, or species of stone—

d. But, it is observable, that many species and families of petrifactions are *common*, in particular strata, which, in others of a similar nature, and belonging to the same tract, are extremely *rare*.††

e. The substance, which forms the petrifaction, is frequently of the same nature as the surrounding rock.—

f. When it differs, it is always found to consist of mineral matter with a finer texture, or grain, than that of the matrix.

---

† Hence, more intimately connected with geological researches, and the various theories devised to explain the primitive state and formation of the globe, than the *conservata*, which usually occur in *modern* or *very modern* strata. Vide § III. Soil, &c.

†† *Echinitæ* are more common in chalk, than in other calcareous strata, apparently deposited at the same period—*Piscine* remains are frequent in bituminous marlite, though rare in common marls and limestones of the same formation.—Some species of *shells* are peculiar to compact limestone, and one (an *ammonite*) to alluminous schistus.—Another has only been found, we believe, in the black, bituminous, shale accompanying our coal-strata.—At least, we have to observe, respecting this last mentioned shell (*Anomia Pecten. Linn.*) that in all the specimens of it, which we have collected in various parts of England, the substance in question has always formed the matrix—nor have we ever seen a vestige of it, in any of the other argillaceous stones attendant on coal.

g. A petrifaction often consists of several distinct minerals. †—

h. Sometimes only of one.

i. The common constituent substances of petrifactions are earths and stones of the *calcareous, argillaceous, or siliceous* class (vide §. III. Substance.)

k. Some of the other earths, and also the metallic, saline, and inflamable bodies, occur in petrifactions, but much less frequently, than the substances above mentioned.

l. Animal petrifactions are observed to be less common, in proportion to the greater degree of locomotive power the originals possessed. ††

m. The vegetable petrifactions most common, are such, as bear the form of plants growing in moist and boggy grounds. †††

n. The petrifactions hitherto recognized, however, as bearing the forms of plants or animals, known to exist at present, are very few, compared with those, the living species of which have not, as yet, been discovered. ††††

---

† Thus chalk and flint often form separate parts of an *echinite*; and in Derbyshire, chert, calcareous spar, bitumen, and quartz, are frequently incorporated together in the same shell.

†† Shells and zoophytes abound in petrifactions; fish and apterous insects are more rare—The petrified remains of the mammalia are still less frequent; and winged insects and birds have, perhaps, never been found in this state.

††† Particularly some species of the *cryptogamia* and *gramina*.

†††† It it true, some of our European petrifactions have been

o. Of petrified shells it has been observed, that some families are most common, which afford the fewest known species in the recent state.†

p. A petrifaction rarely, if ever, exhibits a complete change, or substitution of mineral for organic matter; more or less of the original animal or vegetable substance being generally present, and discoverable either in the external or internal parts of the fossil.††

q. The petrifying process is carried on, in some waters, at this day; but appears to be confined to the formation of petrified wood, or woodstone.

---

ascertained to originate from certain plants and animals peculiar to tropical climates; and a few others, particularly in France and England, have been referred to native species; but the far greater number remains unknown in the recent state.

† *Anomia, nautilus,* &c.—shells of the same genera as those most frequent on our shores, the *volutæ, patellæ,* and *cypreæ,* for instance, rarely occur petrified.

†† This remark, we believe, will hold good in almost every instance; even in what are called the most perfect petrifactions, if they be properly submitted to examination.—In shells and corals petrified, the original calcareous matter is frequently seen covering the surface, or remaining in small portions in the internal parts—(a singular example of this occurs in a specimen of petrified coral described in "*Derbyshire Petrifactions,*" Vide Plate 18. Fig. 2. 3.) and is readily distinguished, although the substituted mineral, forming the principal portion of the fossil, be also calcareous.—In the common vegetable petrifactions of our coal-strata, some vestige or remains of the original bodies, may almost always be traced; and in jasperized wood, which presents, perhaps, the most complete mineral change known, vegetable matter still exists, according to the experiments of Mr. Parkinson. Vide "Organic Remains." p. 344.

r. Petrifactions rarely exist in veins.

C. 5. The *phenomena peculiar* to the conservata are as follows.

a. *Conservata,* for the most part, occur in low or flat tracts, where the strata, consisting chiefly of loose or unconsolidated materials, are evidently of modern formation. †

b. They are also found in the caves and fissures which pervade the more ancient, mountain strata.††—But

c. Are *rarely* incorporated in the stone or other substance, of which such strata consist.†††

---

† The animal *conservata*, that chiefly occur in strata of this discription, are *shells, coral, bones of fish,* and other marine remains—The vegetable, are the beds of *bituminous wood,* found at Bovey, near Exeter, (and in some other parts of England—also in Iceland, various parts of Germany, &c.) and those of *decayed trees and plants, not bituminated,* which have been noticed in most parts of the world, but particularly on the eastern coasts of this kingdom. (Vide Dr. Correa de Serra's paper on this subject. Phil. Trans. 1799. p. 1.) The materials of the strata are principally marls, clays, and sand—sometimes chalk and porous limestones.

†† The *conservata* found in caves, &c. are mostly the bones of quadrupeds.—The caves, or chasms, are generally in calcareous strata; and the inclosed remains, for the most part, invested by stalactitic depositions.

††† The *Conservata* are not wholly wanting among the remains imbedded in the more ancient of the secondary strata.—We have met with very perfect specimens in that state, both shells and corals, lodged in the solid limestones of Derbyshire, and surrounded by complete petrifactions of the same species. These instances, however, are rare; the *conservata* in general being confined to the the strata and other situations above enumerated.

d. They also occur in the beds of rivers, † and

e. In most situations, where mineral or other matter is daily accumulating.††

f. The *conservata* are found in all *states*, between that, in which actual decay, or the separation of the constituent principles of the original, takes place, and that, in which further decay is prevented, either by a new combination in the remaining principles, by an impregnation with mineral particles, or by some other natural process, incident to these bodies.

g. The animal *conservata* most common are such remains, as are most rare in the petrified state—i. e. the *bones* of mammalia and fish—and *shells* of the same genera (often of the same species) as those found in the neighbouring seas.

h. The most common vegetable *conservata* are wood and other parts of *trees*.†††

i. The *conservata* are more frequently referable to plants and animals now existing than the *petrificata*—yet

---

† The bones of quadrupeds, wood, moss, &c.

†† Among the *conservata* found in situations of this kind, are to be reckoned the bones of animals deposited in the banks of rivers, &c., wood and other parts of trees preserved in our bogs and morasses, and lastly, perhaps, turf or peat itself, (of which such bogs &c., generally consist) as long as it retain its vegetable nature and structure.

††† Frequently such as are known in the recent state.

k. Many occur, which do not appear to belong to any known living species.††

l. The *conservata* are not uncommon in mineral veins.†††

Origin.

The origin of *extraneous fossils* is obviously demonstrated by the attendant Phenomena. (§. II. 3. 4. 5.)

A. 6. Conservata cannot properly be said to originate *from,* since they really *are,* the *remains* of plants and animals, introduced by different processes of nature, into the mineral kingdom. (§. II. 1.)

---

†† Particularly among the remains of the *mammalia.*

††† At least in those which intersect secondary strata. Many instances of both animal and vegetable remains, in the state of conservata, occurring in mineral veins, have fallen under our own observation, and others well authenticated might be adduced. We shall here only notice two,—*Fir-trees,* found in a lead-vein in Wales some few years back, the wood of which was unchanged, except in being strongly *impregnated with galena,* (we are obliged to A. Mills, Esq., of Dublin, for our knowledge of this fact) and the *entire skeleton* of a very large elephant, discovered about 90 years ago, in *working* a vein of lead near Wirksworth, (Derbyshire). The skeleton was found at the depth of 40 yards, and, from the written account which remains with such parts of it as were collected, appears to have been in a very complete state of preservation. One of the *grinders* we examined lately in Mr. Watson's possession, at Bakewell; and found it to differ little from a recent tooth of the same kind.

B. 7. Petrificata owe their *form* to organized bodies; their *substance* they derive generally from *minerals*. (§. II. 2.) †

---

† The origin of extraneous fossils, particularly of petrifactions, has afforded a subject for much speculation among the learned. About the beginning of the last century, the writings of our English naturalists were filled with disputes and contradictory opinions on this head; many esteeming these productions to be mere *lusus naturæ*, while others ascribed their formation to an imaginary *plastic power* of the earth, by which, it was contended, stones and other fossil substances, with the regular form of animals and vegetables, might be generated.—Another singular theory of the time, proposed to explain the origin of these bodies, was that of the learned and ingenious Lhwyd, who supposed extraneous fossils to be generated by seeds and spawn taken up in vapour, and, after being precipitated in rain, deposited by the percolating water in the crevices and fissures of the earth.—Here, according to the hypothesis, meeting with a proper matrix, the seminal particles gradually expand, and produce fossil bodies, in form resembling the parent animals or vegetables. (Luidii Lithop. Brit. p. 136.) In opposition, however, to such futile opinions, several philosophers of the period above alluded to, maintained, that *formed stones* (as this class of fossils was then generally called) were real organic bodies petrified; or, at least, stones moulded in cavities previously filled by animal or vegetable matter—a position now fully established, by the multiplied observations of succeeding naturalists. For the controversy on this subject, vide the works of *Ray*, *Hook*, *Lhwyd*, *Woodward*, *Lister* *Plott*, *Morton*, *Leigh*, &c. &c.

Introduction into the Mineral Kingdom.

It is inferred from the foregoing Phenomena, that the introduction of extraneous bodies, into the mineral kingdom, has been effected in *various modes*, and at *various periods, during a succession of ages;* but, with respect to those, from which the *petrificata* derive their form, chiefly *while the superficial parts of the globe were in their primeval soft, or liquid state,*†† *and the ocean far above its present level.*

---

†† Mineralogists by no means agree in their suppositions respecting the period or manner, in which organized bodies have been introduced into the fossil world. The deluge was formerly considered by many, as an event in the natural history of our globe, which satisfactorily accounted for the accumulation and interment of extraneous remains, in every situation—even when found at the greatest depths, and enveloped in the hardest substances, in which these bodies occur. By modern geologists, however, and indeed by those who are the most strenuous in contending for the universality of the deluge (vide Mr. Kirwan's Geol. Essays) this catastrophe is not esteemed adequate to the production of those appearances, which organic fossils generally exhibit; and, at most, is only supposed to have been the cause of partial and superficial depositions of these bodies—such as are discovered in loose or travelled materials, or merely in the external clefts and chasms of genuine, solid strata.—Hence (with reference to that deep and extensive mass of imbedded, marine remains, which limestone tracts usually afford) it has been observed, " Ubi testacea et lithophyta fossilia existunt in magna copia, ibi quondam fuere maris littora aut abyssus, cum sint mera vestigia maris, *omni historia*

The subject of the present section presents itself under two heads—The *Periods* at which, and the

---

antiquiora; Diluvium vero *non demonstrant,* sed tantum *longioris ævi rudera.*[h] Syst. Nat. The systems of a Woodward and a Burnet thus rejected, and it must be admitted, we think, by all who have well attended to the subject, rejected on sufficient grounds, recourse has been had to other theories, which might better explain and connect the various facts, established in the study by those, who, not satisfied with a mere inspection of extraneous fossils in cabinets, have investigated these relics of unknown ages, as objects of geological importance, in their mineral beds.

With naturalists who have *thus* cultivated a knowledge of these bodies, it is now a generally received *principle,* that *extraneous fossils are the productions of different periods.*—This assumption is supported by various phenomena: principally, however, by the different states, in which these bodies are found—by their occuring in strata, which, from facts not connected with *reliquia,* are evidently of various formations, and by the agreement observed between these *different states,* and the *periods* at which the inclosing strata are supposed to have been deposited.—In superficial strata of *modern* formation, the organic remains being scarcely altered from their original state—while in strata of a more *ancient* order, and, in point of relative situation, inferior to the preceding, they are, for the most part, completely mineralized. The next principle adopted in the study is, that *the introduction of extraneous bodies into the mineral world has been effected by various causes.* This proposition will not be disputed by those, who have attentively examined the facts, from which it is deduced.—It is obvious, that the same cause could not involve *marine remains* in the heart or substance of a rock, which collected and deposited, in its clefts or fissures, the relics of *land-animals* only—that the means, whatever they might be, which nature employed in dispersing the bones of elephants and other quadrupeds, in a loose and comparatively superficial state, over various tracts of country, were not the same as those, by which vegetable remains have been infixed, at the greatest depths, in the earth, and made integrant parts of solid strata—neither, it is almost needless to add, can we suppose, that *exactly* the same natural operation could, at one time, form accumulations of sea-shells and corals, and deposited them in calcareous strata, and, at another period, collect the remains of plants only, and bury these in beds of argillaceous matter. As, however, a diversity in the time and mode of introduction into the mineral kingdom, will scarcely be denied to extraneous fossils, it only remains with us to point out the theory, which, in our opinion, best agrees with the principles just stated,the foundation of those assumed above, as our text.

It is evident, that a theory of the mode, in which organic bodies have become subjects of the mineral world, includes, in fact, a general inquiry into the formation of the earth, since extraneous fossils exhibit some of the principal phenomena, on which such an investigation must be founded.—The various theories hitherto devised for illustrating the primitive state, as well as the present structure, of our planet, have been reduced to two classes.—The *Vulcanic* and *Neptunian*—the first referring the origin of most mineral phenomena to *fire*; the latter, to *water*. Of these two classes the last has most consistently adapted its principles to the facts, which extraneous fossils present; and, among the different "theories of the earth" constructed by the Neptunists, that of WERNER, or at least that, which the geologists of his school propound as his, seems best calculated to stand the test of experimental inquiry.

Neither the limits nor design of this introduction, however, permit us to give a detail of the *Wernerian system of geology* in all its parts; but, in the following sketch will be found most of its leading propositions; or, at least, such of them, as more immediately apply to the object of the present work—to these are

A. 8 The *periods* of introduction may be reduced to three principal and determinable ones—

---

added a few cursory observations and notices, illustrative of the geological opinions of De Luc, Hutton, &c.

FORMATION OF THE EARTH,
AND
Introduction of Extraneous Fossils into the Mineral Kingdom,
According to the modern Neptunian System.

1. The materials which compose the globe, or at least its superficial parts to a certain depth, have been in a soft or fluid state.

(Obs. De Luc supposes our globe, during the first periods of its existence, to have consisted of a dry, central mass, with another concentrical to this, in a soft or mud-like state, and a liquid covering the whole, and containing the various substances, which afterwards formed by precipitation the primordial strata.)

2. This fluidity was the effect of solution in water, and not of igneous fusion.

3. The different *earths*, together with the *saline*, *inflammable*, and *metallic* substances, thus dissolved or suspended in water, constituted what has been called the chaotic fluid.

(Obs. Mr. Kirwan believes, that the various mineral substances, which the surface of the globe at present exhibits, were at the very commencement of their existence, in that state of minute division, aqueous solution requires; and, of course, not orginally created in a solid or compact form, and afterwards dissolved, as some authors, who support the Neptunian theory, have supposed. Vide Geol. Essays, p. 10.)

4. From this fluid, the substances just specified were successively and, *at distant periods*, gradually deposited.

5. These depositions were either chemical or mechanical.

(Ob. Stones originating from mechanical deposits are distinguished by the want of the sparry or crystalline texture; or, more generally, by their integrant parts exhibiting traces of fracture and attrition; as in some sandstones, pudding-stones, certain limestones, &c. In chemical deposits there is no such appearance, the con-

a. 9. *The first period,* commencing with the existence of *marine animals,* and ending with the

---

stituent particles having been consolidated by crystallization; as in granular limestones, granite, gneiss, &c.)

6. The first deposits from the chaotic fluid were chemical, consisting of siliceous and argillaceous earth, a small proportion of the calcareous and magnesian, with various metallic particles, particularly iron. These ingredients partially separated, and crystallizing according to the laws of elective attraction, produced in the first instance *quartz, feltspar, mica,* &c., which, collectively concreting, formed rocks of the *granitic class.*

(Ob. Hence, granite and its varieties are universally found to underlay other rocks; constituting, as it were, the fundamental basis, on which stones of subsequent formation have been deposited.)

7. After *granite,* other *primary* rocks were deposited, as *gneiss, micaceous schistus, argillaceous schistus, porphyries,* &c.—*previous to the existence of organized bodies.*

(Ob. Inferred from these rocks never exhibiting organic remains in their compositions. In some instances, granite, gneiss, &c., appear to be coeval.)

8. These *primary* rock formations were not generally deposited in concentric *strata;* but mostly in immense, irregular *masses,* of which the more elevated parts now constitute the highest mountains of our globe.

(Ob. Even *secondary* mountains, according to Werner, owe their elevation to the structure of the *primary* rocks, on which those of secondary formation, were deposited—and hence, the strata in secondary mountains are more or less inclined, according to the direction of the base, on which they are incumbent. That the primary depositions would generally assume a massive form, or if a stratified, that the position of such primary strata would be vertical or highly inclined (the state in which they are mostly found) is inferred from the known properties of crystallization, by which formation of *plants*; the surface of the ocean being then so much above its present level, as to cover the summits of all *secondary* mountains. (v. §. III. Soil.)

---

process, and not by that of a mere mechanical subsidence, the materials of primative rocks, as just stated, are supposed to have been compacted. Vide G. Essays, p. 21, also View of Nept. and Hutt. Syst. Geol. p. 106, where the massive structure of the unstratified primary rocks, and the frequent vertical position of the beds in such as are stratified, are accounted for on Werner's principles.

De Luc, in explaining the formation of mountainous tracts, and the dislocation of the strata which compose them, states, that all rocks were formed by simple deposition, and that, consequently, the original position of the strata was horizontal.—That these horizontal strata, constituting the bottom of the ancient sea, from which they had been gradually deposited, formed a kind of shell or crust, over a mass of moistened matter, with which the original, *dry*, central part of the globe was surrounded. (see former Obs. to prop. 1.) That during the consolidation of these strata, the water, from the mass under them, was gradually absorbed by the dry substances in the centrical nucleus; and hence, in process of time, instead of a uniform, *soft* support to the incumbent beds, one of a *solid* but ramified structure was formed,—the mineral materials, of which it consisted, coalescing and becoming compact on being deprived of moisture. That, in proportion as the branches of this support were more contracted by subsequent consolidation, the intervening cavities were necessarily extended; and that, at length, the superficial crust gave way, in different parts of the earth's surface; and while one edge of a fragment sunk down, the other remained elevated on the solid ramifications, which had previously supported the whole external shell of concentrical strata. Thus our author endeavours to explain the retreat of the ocean, into the, at present, depressed parts of the globe, the first appearance of the *great mountains* which branch through our continents, and the va-

Obs. During this period the *most ancient* of the secondary tracts were formed, and the remains of *zoophytes* and *shell-fish*, the only animals apparently

---

ried and disordered position of the *secondary* strata, which rest against them.

In Hutton's system of the earth, mountains are considered as the production of subterraneous heat. The Doctor supposes our present habitable earth to have been formed of materials furnished by the decay of one more ancient. These materials, collected at the bottom of the sea, and horizontally arranged by the action of the water, were first consolidated into strata by an intense subterraneous heat, and afterwards broken and elevated by the eruptive force of the same agent, acting on mineral matter in perfect fusion. Thus he accounts for the emersion of our continents from the depths of the ocean, the formation of mountainous tracts, and the various direction and positions, in which their strata have been thrown. The ejected matter, which accompanied these effects, still exists, according to his theory, in the substances of veins and unstratified rocks, of which last trap and granite are the principal. Hence according to Dr. Hutton, granite is a more recent rock formation than the superincumbent strata of other stones and earths.

The action of subteraneous fire, under various modifications, has been used, also, by Whitehurst, Lazzaro Moro, Faujas St. Fond, Born, Raspe, and many other authors, in explanation of the phenomina of *mountains*, and the derangement of the strata which compose them.)

9. After the formation of the primary rocks, the water, which hitherto covered the entire surface of the earth, began to diminish in height, and the more elevated parts of our continents to appear.

(Obs. Hence the secondary mountains never attain the height of the primary, being deposited when the waters were lower than the summit of these greater rock formations.

The diminution in the height of the water is accounted for, by then existing, enveloped in the substance of the strata.

---

supposing, that the ocean, after the first deposits, began to retire gradually into the *internal cavities* of the earth. It need not be pointed out to the scientific reader, that the assumption of subterranean caverns, capable of containing the vast body of water, which according to the Neptunists covered the whole surface of the globe, forms one of the most exceptionable principles in their theory.)

10. Soon after this period organization commenced—*marine animals of the Vermes class being first created, and their remains gradually enveloped by subsequent depositions from the ocean.*

11. The depositions immediately after animal life commenced were partly chemical, partly mechanical—

12. The chemical consisted of such matter, as was originally dissolved in the ocean—the mechanical, of such materials as its long continued action, on the emerged parts of the globe, had again, for a time, suspended.

(Obs. These depositions form the *intermediate* or *transition* rocks of Werner. They rest immediately on the primary, and contain but *few* petrifactions, which are always marine—generally shells or zoophites.)

13. The strata formed by these depositions were chiefly of *rubble-stone, sandstones,* some *limestones, breccias, argillite, cherts,* and, perhaps, *porphyries* and *sienite.*

14. The water, after depositing these latter formations, continued to diminish; consequently, in process of time, a larger extent of land was uncovered, and fitted for the reception of *animals* and *vegetables.*

15. The partial disintegration of the emerged strata being still carried on, *the remains of such animals* and *vegetables, as had existed on those portions of the earth, which the mechanical ac-*

b. 10. *The second,* commencing with the formation of *plants,* and an increase of *those animals* which

---

tion of the surrounding waters had destroyed, were collected by the ocean, and after a time deposited, either with the mineral materials recently acquired, or the remainder of those originally suspended in the chaotic fluid.

(Obs. We are not assured, that the *Wernerian Geognosy* employs this proposition *alone,* to explain the formation of what are termed *stratified rocks* (Vide. prop. 16); but if so, must remark, it by no means accounts for the phenomena attendant on certain coal tracts, and others, consisting of strata of this order, in which *vegetable remains are found unaccompanied by marine relics.*)

16. The rocks formed at this period, containing more mechanical deposits than the precedent, were more generally arranged in horizontal strata.

(Obs. Hence Werner distinguishes them by the title of stratafied rocks. They abound in petrifactions.—The latest formed containing the most vegetable remains.)

17. They consist principally of *limestones, sandstones,* and *puddingstones; gypsum, trap,* and various *coal-strata*— more rarely *argillite, porphyry,* and some other substances.

18. They constitute mountains frequently, but of a height much inferior to those composed of primitive (6. 7. 8.) or transition rocks (10. 11. 12. 13.) on the sides and extended bases of which they were deposited.

19. After this period, the sea gained gradually its present level, and its last depositions were, for the most part, such substances, as now compose the low hills and plains, between the more mountainous parts of the earth.

20. Such are chiefly the various *chalk-strata,* perhaps some *limestone* and *coal?*—with *sand, clay, marl,* and other unconsolidated materials.

are peculiar to the ocean—ending with the time, at which the ocean, after a gradual subsidence

---

21. Alluvial and Volcanic tracts have been formed at various periods; but, in general, since the sea retired within its present limits.

(Obs. Alluvial beds have been deposited by rivers, lakes, and inundations of fresh-water. The *modern* are found in vales, on the banks of rivers, and other low situations. They principally consist of gravel, sand, clay, &c. the *debris* of more ancient strata. The *ancient* alluvial are, *perhaps*, some *sand-stone*, *shales*, and *coal-strata*.)

22. *Veins* have also been formed at various periods, during the consolidation of the strata they traverse; but generally before the sea had quitted the mountainous parts of our continent.

23. Veins were originally empty rents or fissures, open at the surface of the rock or stratum, through which they run.

24. These fissures were gradually filled, with the mineral substances they contain, through their openings, from above.

(Obs. According to Werner's theory of Veins.—Mr. Kirwan is of opinion, however, that, though some veins have undoubtedly been thus filled, the materials in most have been deposited by successive percolations.)

Such are the leading principles of the Neptunian Theory, now generally adopted by the Wernerian school. The geological facts, on which these principles are founded, are very numerous; those which appertain to extraneous fossils we have stated; for the rest, we must refer our reader to the works of Werner, De Luc, Saussure, Pallas, Charpentier, Kirwan, Jameson, Williams, &c. Those who wish to examine the objections to which the Neptunian system is liable, may consult, with great advantage, Professor Playfair's excellent "Illustrations of the Huttonian Theory of the Earth," and an answer to the same, of considerable merit, intitled "a comparative view of the Huttonian and Neptunian Systems of Geology."

through several ages, first attained its present level. †

Obs. During this period, the *less ancient* and some of the *modern tracts* (v. §. III. Soil.) were formed; and the remains of *plants* and *fish*, as well as *shells* and other relics of the *vermes*, added to the fossil world.

Towards the middle of this period, it is probable the *mammalia* and other *land-animals* were either created or considerably encreased in number, as their remains are found, though *very sparingly*, in some *modern* strata, supposed to have been deposited, just before the sea had finally retired to its present limits.

c. 11. *The third period* commences with the reduction of the ocean to its now actual level, and continues down to the present day.

Obs. Throughout this last period, *modern* and *very recent* tracts of alluvial and some other strata, &c., have been deposited, and various extraneous fossils, particularly the remains of the *mammalia*, introduced into the mineral kingdom.

---

† The subsidence of the ocean, assumed above as a ready illustration of our subject, is by no means contended for, as indubitably established. That a *gradual change*, in the relative level of the sea and land, has taken place, is a fact proved by numberless phenomena; but it is of little moment in the study of extraneous fossils, whether this change is considered as the effect of depression in the water, or of elevation in the surrounded continents. In either case, the same agents must have operated in the introduction of organic bodies into the mineral strata, thus elevated above, or abandoned by, their parent element.

B. 12. The *agent*, by which the introduction of extraneous fossils into mineral strata &c., has been chiefly brought about, is evidently *water*—i. e. of the *ocean* —of ancient *lakes* and *inland-seas*—of *rivers, currents,* and *modern lakes*—of *local inundations*—of, perhaps, the *general deluge.*

a. 13. *The ocean*—to the agency of which, when in a *primary state,* and during the *first period,* (9.) is to be referred all deposits of *sea shells* † and other marine bodies found in strata, which immediately follow granitic rocks, or which *dip* under, but do not *alternate* with strata, holding the remains of *fish* or *plants.*

To the same *agent,* but more nearly approximating to its *present state,* †† during the *second period* (10.) are to be ascribed all other accumulations of organic bodies, in which *marine remains* make a considerable part, and which are deposited in *regular, determinate* beds of stone or other matter.

Obs. The process by which these remains were enveloped or surrounded by their present mineral beds, in most instances, appears to have been that of simple deposition; but under various modifications.

---

† "Shell fish appear to be of all others the most ancient; perhaps the reason might be that they could live in water more turbid with heterogeneous ingredients, and more fouled with petrol, than other fish, or because the sea was originally more salt." Kirw. G. Essays. p. 30. note.

†† Some modern naturalists consider the envelopment of animals and vegetables in mineral strata to be still carried on at the bottom of the sea, under the *present* constitution of our planet—among these are Buffon and Dr. Hutton. The latter has assumed it as a leading principle in his Theory of the Earth.

Sea-shells and other marine bodies, possessing but a *small degree* of *locomotive power*, evidently have been generated, have lived, and died, in the same accumulated heaps their remains now exhibit. These have, apparently, in some instances, been *gradually intombed*, by matter, precipitated from an immense body of water, *slowly, without alteration, through an unknown length of time*; and, hence, forming strata of great thickness. These strata hold, *throughout their whole substance* extensive beds of shells and other organic bodies, the production of which must therefore have kept pace with the increase of matter deposited—an accumulation of mineral and organic materials thus, by degrees, arising together.

In other tracts, marine bodies of the *vermes* class have been *more quickly* enveloped. The matter of the deposition having been repeatedly changed, forms, in such cases, only thin, successive strata of various kinds of earths and stones, *alternating* with each other. In these tracts, the *reliquia* generally occur *between* the strata, that is, in the seams or interposed layers of clay, &c., (*semi-strata*) or towards the *surface* of each bed, the middle part, or body of the constituent substance, being often void of organic remains. These appearances indicate the strata to have been formed at distant intervals of time; and, that the deposition and consequent accumulation of mineral materials, in each stratum, were too sudden to allow an equal increase to the bodies enveloped.

Fish, or *other marine animals,* endued with *a great degree of locomotive power,* have, probably, been arrested in their course, and instantly killed, by some sudden diffusion of matter, inimical to animal life.† Hence, piscine relics occur imbedded in *shoals,* as it were, in those strata which are peculiarly the repositories of such remains.

Where *vegetable* fossils, whose originals grew on dry land, are found mixed with *marine shells,* &c., in *deep and regularly disposed beds,*†† it is obvious a transportation of vegetable bodies from the land to

---

† It may be somewhat difficult to conceive, how a diffusion and subsequent deposition of matter, fatal to fish and other swift-moving animals, could take place in those parts of the ocean, which were previously habitable for such animals, and, of course, not greatly contaminated by mineral ingredients. That the cause of the event was sudden, and that the inclosure of the fish, &c., almost instantly followed their loss of life, is pretty evident, from the attendant phenomena. Mr. Raspe has considered all this, as having been effected by sub-marine volcanic eruptions (*v. Raspe. Ferber's It. pref. p.* 28.) A similar idea is adopted, with much success, by Mr. Graydon, in his excellent account of the *Monte Bolca* fish. These he supposes have been enveloped in a diffusion of *lime,* arising from immense masses of calcareous stone, ejected in a calcined state, by sub-aqueous volcanoes. (v. Irish Trans. vol. 5. p. 310.)

†† The phenomenon of vegetable remains being sometimes found mixed with those of the sea, has been brought forward as a proof of the agency of the *deluge,* in the interment of *all* organic bodies in mineral strata: but, in opposition to the inference in question, it is very justly observed, that, where extensive beds of sea-shells &c., occur, though mixed with vegetable remains, *in regular strata,* the appearances indicated are incompatible with the turbulence and short duration of the deluge; at least agreeable to

---

the Mosaic account of that event. Regular stratification can only have been the effect of regular and long continued depositions; and such could not have taken place during a ten-month's flood, even admitting it to have been universal. It has been assumed, however, to obviate the force of the objection, that, on the general subsidence of the deluge, a portion of its waters would remain in various excavated parts of the continents, and there form extensive lakes or inland-seas: and that, in these lakes have been *gradually deposited*, not only the strata now under consideration (viz. those in which a mixture of sea-shells and vegetable remains occur) but also many of those productive of coal, in which no admixture of marine exuviæ are found. The hypothesis is ingenious, and undoubtedly not inconsistent with the structure and general appearances attendant on coal-strata, which frequently indicate their formation to have been carried on, in the depressions or hollow parts of more ancient strata. We cannot, however, acceed to the conclusion, that the water, once filling such depressions, must have originated from the general deluge. According to sacred history, the full development of the animal kingdom, as well as of the vegetable, had taken place long before the period, in which they were equally involved in one general inundation. And hence, in strata supposed to have been formed by depositions from water left by the deluge, not only, might we reasonably expect to find vegetable and marine relics, but also, the remains of *land-animals*, of quadrupeds for instance, and even of *man himself.*—For, however small a proportion the destroyed land-animals bore, among the general multitude of organic bodies overwhelmed by this catastrophe, —as they *did* exist, and as the bones of quadrupeds are certainly as liable to subsidence in water, as drifted timber, or other vegetable matter, they, no doubt, would occasionally be met with, in the strata in question, if such strata had really originated from the cause assigned in the hypothesis. But, on the contrary, it is an indubitable fact, that neither the remains of man, nor of quadruped, have the sea † must have taken place. In such instances, it appears probable, that plants and wood, specifically lighter than water, would remain floating for a certain length of time, before their deposition

---

ever yet been found in stones or earths constituting strata productive of genuine, mineral coal; nor, indeed, as integrant parts of *any strata,* excepting those which are decidedly of much later formation, than such as we are now treating of. To a far remoter period, therefore, than that of the flood, must we recur, in any endeavour to explain or illustrate the agency of nature, in collecting and depositing the materials of *regular disposed strata, holding vegetable remains alone, or mixed with relics from the ocean; and immediately followed primary rocks, or such secondary, as contain only the vestiges of shells and zoophytes.*

† By the means of floods, rivers, and various other causes—The reader will observe, we are here referring only to such strata as consist of extensive and, apparently, undisturbed beds of sea-shells &c., mixed with a *few* vegetable remains.—Where the testaceous remains and those of the vegetable kingdom are more equal, and promiscuously mingled together, (But have strata holding organic remains in this state ever yet been found?) or, where they separately occur, in alternating strata, as they most certainly do in some rare instances, a transposition of materials from the sea to the land may be supposed to have taken place, rather than from the land, to the sea. This may have been effected in different ways. The subsidence, occasioned by earthquakes or other causes, in strata formed, or forming, by depositions from fresh-water, may have subjected such strata for a time to the sudden inroads of the sea, and a mixture of marine and vegetable relics would of course be the consequence.—Where the remains of plants and sea-shells, &c., are alternately exhibited in distinct beds, both a regular, periodical influx of the sea, and, in the intervals, a formation of strata from inland causes, seem to be pointed out.

at the bottom of the sea, could be accomplished: and that this, at last, must have been effected by a gradual attachment of mineral particles (such as the ocean then abounded with) to the surface of these floating *leaves, stems,* &c.—Thus inducing in each individual, that degree of specific gravity necessary for its subsidenc eand final deposition, in the depths of the ocean.

b. 14. *Ancient lakes and inland-seas.* To the agency of these, during the *second period,* are perhaps to be referred all depositions of vegetable bodies and fluviatile shells, embodied in *deep and regular strata,* and not mixed with marine remains, —also, in some instances, those deposits of plants, &c., in which marine bodies *very sparingly* occur.

To these agents also, but during the latter part of the *second period,* are to be ascribed many of those deposits of vegetable matters, which occur in *less deep or regular strata,* and which occasionally exhibit the remains of *mammalia,* without any mixture of sea-shells or other marine *exuviæ.*

Obs. On the retiring of the ocean from our continents, no doubt, extensive lakes and inland-seas were left in the hollows and depressions of the original strata. The waters of these lakes, &c., would for a time retain the nature of the sea, of which they once formed a part; and hence, the mixture of marine remains in their primary deposits. In process of time, from the deposition of the matter first held in solution, and from the continued influx of fresh water, the nature of these inland-seas would be changed; and their deposits, of course, contain only the remains of *animals* capable of existing in such waters (fluviatile shell-fish, &c.) and the *vegetable* and mineral materials poured into them by rivers and torrents.

The deposition of vegetable matter, &c., in inland-seas, would be carried on, for a certain length of time, under the same processes as those supposed to have taken place in the ocean.

The accumulation of materials, however, arising from the daily disintegration of the surrounding mountain rocks, and the consequent debasement of these barriers, must at length have reduced the lakes and seas to the state of extensive tracts of low, flat lands, scarcely covered by water. Over these tracts, laid dry, perhaps, at particular seasons, vegetation peculiar to swampy grounds would doubtless soon commence; and, when the flat or concave basis was again covered with water (the consequence of periodical rains, &c.,) would afford a supply of submersed, organic materials, ready for incorporating with the next deposit of mineral matter, brought in by streams and torrents from the circumjacent hills. This process being repeated, a succession of strata would be formed, abounding in plants peculiar to low and moist situations.†

---

† Such are found, generally, in the upper beds of clay, ironstones, &c., accompanying coal tracts; and, from the different species occuring in separate accumulations (at least in most in-

In still more recent strata, formed in this manner, the bones of such land-animals would also be deposited, as the earth, in this period of its existence, was fitted for supporting.†† .

c. 15. *Rivers, currents and modern lakes.* The influence of these, in the immediate deposition of organic remains among mineral matter, is only to be traced in those accumulations of sand, gravel, clay, &c. which are evidently the production of the *third period.*††† .

The organic remains found in such situations are,

---

stances) appear to have grown on the very spot in which their remains are now intombed.

†† These animals, as already remarked, must have been at this period but sparingly distributed over the earth, since their remains occur so rarely and *only* in the most recent of the strata, of the formation we are now considering—Had they been long created, or had they, at this epoch of time, existed in considerable numbers, their relics would now, doubtless, be as common in such strata, as they are in the more irregular and superficial alluvial beds of the succeeding (3d.) period.

††† It is not, that we suppose rivers not to have existed during the *second period,* that we have confined their operations to the *third:* on the contrary it is highly probable that they began to flow long before the sea gained its present limits; and, perhaps, it would not be going too far, to assert with Dr. Hutton, that " on our continent there is not a spot on which a river may not formerly have run." (Theory of the Earth, vol. 2, p. 234)—But the loose and irregular depositions, from streams and currents of these early ages, must long since have been obliterated by that waste and degradation, to which even the most solid strata (the productions of deep and still waters) have been subject.

principally, wood[†] and the bones of mammalia. Plants, as moss, &c., and land and fresh-water shells occur also in the banks of such rivers as afford a stalactitic tufa.

d. 16, *Local inundations*. To these agents, since the commencement of the *third period*, are perhaps to be referred most *superficial* accumulations of organic fossils, not deposited in regular strata, and which are not immediately connected with the present or former course[††] of still existing rivers.

Partial inundations of *fresh waters*, in many instances, appear to have occasioned the deposits of *animal bones*, so frequent in the loose earth or soil of those alluvial tracts, which have not, seemingly, originated from the deeper, but more contracted influence of rivers and currents. To sudden inundations, also, are perhaps to be ascribed the destruction, at least, of those *animals,* whose bones are found in clefts and chasms of ancient strata.†

[†] Often forming *deltas* at the mouths of large rivers.

[††] Extensive depositions of sand, mud, gravel, &c., connected with a river, but considerably higher, as well as lower than its present level, may be supposed to have arisen from successive inundations of such rivers; but, in general, will be found to have originated from deep and wide spread *lakes*, united by a constant stream or current; the beds of which lakes have gradually assumed the form of alluvial land, and their contracted waters that of a river, now taking its course through the materials deposited in its former state. (For some excellent observations on the formation of alluvial land by modern rivers and lakes, vide Playfair's Illustrations, p. 350.)

The extensive beds of vegetable matter, consisting for the most part of trees, which have evidently grown and fallen on the spot, where their remains now lie deposited, and which are common on low, flat coasts,†† are doubtless the vestiges of *inroads and local inundations of the sea.* Such, also, appear to have been the cause of those *superficial* accumulations of marine remains, in an unmineralized state, which are frequently discovered, on low tracts of land,††† at considerable distances from sea.

---

† The accumulations of bones which have been discovered in *some* caves, are, perhaps, the gradual production of successive ages, rather than the effect of any single inundation or other catastrophe.

†† Vide *Dr. Correa De Serra's* survey of a submarine forest on the east coast of England. Philos. Trans. 1799, part 1. p. 145. Similar accumulations of vegetable matter have also been observed on the western coast of this kingdom.

††† It perhaps may be doubted, if any deposition of organic bodies has ever yet occurred, *unequivocally* demonstrative of a general flood.—The shells found in Peru on a mountain considerably higher than any affording similar remains in Europe (vide Hist. Acad. des Sciences, 1770. Phys. Gén. n. 7.) appear to have been perfect petrifactions, included in the substance of the stone of which the mountain consists; of course, they prove the submarine formation of the rock in question, but not that its contents have been elevated to their present situation by the deluge, as some geologists have supposed. Even loose or unconsolidated deposits of marine remains, sometimes found, according to Pallas, in the more external fissures and veins of lofty primary rocks, in

e. 17. *The general deluge*—can only be referred to as the agent of *superficial* depositions of *marine and other remains, mixed promiscuously with each*

---

which extraneous fossils do not occur as integrant parts, are no certain proof of this event.—It is highly probable, that *secondary strata* have originally covered many elevated tracts, where there is, at present, no appearance of such formation; and hence, the deposits in question are, perhaps, merely the *debris* of such strata, long since decomposed.—That the disintegration of stratified rocks may have produced materials, with which, in some instances, the cavities, and even veins, in primary mountains have been filled up, is a supposition by no means inconsistent with the general phenomena of those tracts; and, that extraneous fossils formerly imbedded in secondary strata, will remain in a very complete state of preservation, long after their original matrix has been destroyed, is, indeed, a fact sufficiently illustrated by the loose *reliquia*, so abundant in the common soil of some countries, and which have been liberated, undoubtedly, by the waste and decay of their native rock. When, however, the remains of marine, and of land-animals, occur together in *superficial accumulations*, they certainly exhibit a less ambiguous evidence of the deluge, than, such as we have just been recounting: yet not altogether a decisive one, except both kinds of *reliquia* are found in a similar state of preservation.—If, on the contrary, the shells, &c., are *petrified* and the bones in nearly a recent or *unmineralized* condition, it is obvious they were not originally introduced into the fossil kingdom at the same period, whatever common cause may have brought them together at the present time; and, hence, the support, which the presence of marine objects gives to the conclusion, that such deposits are truly diluvian, is done away with.—Were the marine remains, it has been justly observed, in the same state as the bones—" then the conclusion that both had been imported by the sea would have great probability; but without that, *other, and loged in cavities, &c., at heights to which no partial inundation of the sea could reach.* Such depositions belong also to the *third period.*[††]

---

their present union must be held as casual and can give no insight into the origin of either."—Playfair's Illustrations, p. 475.—It must not be inferred, however, from the foregoing objections, that we wish to establish a disbelief of the general deluge.—The existence of that event is confirmed by authority far above the evidence of geological facts—But, in the present study, it is particulary necessary to guard against the too common error, of ascribing effects to causes, inadequate to their production.

[††] No attempt has been made above to point out separately the periods, in which extraneous fossils have occasionally been introduced into veins; but it may be here generally observed—1. That all geologists admit the formation of veins to be subsequent to the consolidation of the rocks they traverse—2. that different dates of formation belong even to those found in the same tract or range of strata—and, 3. that Werner supposes a vein, consisting of various substances, to have been formed at various times, by successive depositions or crystallizations.—Consequently the introduction of extraneous fossils into veins has always been at a less remote epoch, than that of the depositions of such bodies in the rock through which the veins run—and, agreeable to the Wernerian theory, even plants and animals belonging to very distant ages, may be enveloped in the materials of the same vein. The agency, which nature has employed in filling veins, is undoubtedly that, by which the formation of the strata themselves has been effected; and we may conclude, that extraneous bodies have, in general, been carried into veins while the rocks, in which they exist, were still under water.—In some instances, however, it would appear, that vegetable and animal remains have been deposited, by floods and various other accidental causes, in veins which have been formed since the emersion of the strata from the ocean.

§. III.

DISTINCTIVE CHARACTERS OF THE RELIQUIA.

Are the characters used in describing and distinguishing these bodies; and depend on their *mode,* FORM (essential and accidental,) PROTOTYPE, *substance,* and *soil.*

Obs. The essential FORM distinguishes *reliquia* from other fossils.

The essential FORM, PROTOTYPE, and SOIL, characterize the *orders* (v. Syst.)

The essential FORM and PROTOTYPE, the *genera, species,* and varieties.

The SUBSTANCE, accidental FORM, and SOIL, the *specimens.*

Mode. (Modus.)

The *mode* of extraneous fossils respects the *state* or *degree* of *mineral change,* under which the *form* of the original has been preserved.

Reliquia retain the form of their prototype under the more or less perfect *conservation* of the *original body,* or under a general *substitution* of *mineral* for *organic* matter.

1. CONSERVATION *(conservatio).* In this process the *substance* of the *original* is preserved

with its *internal texture,* or that peculiar disposition of the constituent particles, which distinguishes organic from inorganic matter.

Conservation is effected under, 1. a *privation,* or *loss* of some of the parts or constituent principles of the original matter, 2. a *conversion,* or *chemical change* in the combination of the remaining principles, or, 3. a *mechanical impregnation* with mineral particles.†

2. PRIVATION *(orbatio.)* Conservata, in most instances, are found wanting in the oily and volatile principles, which were present in the recent body; the more fixed and earthy alone remaining under the organic form and texture.

Obs. In this state the *fossil bones* of land-animals frequently occur;†† *insects* preserved in amber;—also *shells, corals,* and other marine

---

† The different *modes,* in which the *conservata* occur, are here considered as distinct; but it will be obvious, that they are rarely if ever so in nature.—They all, indeed, frequently take place in the same individual; and the first, namely *privation,* is common to all extraneous fossils.

†† Recent bones consist, principally, of *phosphate* of *lime* and *gelatin,* mixed with a small proportion of the *carbonate* of *lime.*—The fossil subjects often retain a portion both of the *gelatin* and *phosphoric acid* in their composition, particularly in their interior parts; the surface only having undergone a *privation* or loss of these principles. In other instances, however, the gelatin and phosphoric acid are wholly displaced; while a greater proportion of the carbonic acid, than that which existed in the original state, is found to be united with the calcareous matter.

In Professor Playfair's "*Illustrations*" are many excellent remarks on the different states, in which fossil bones are found.—Some of these which are applicable to our present subject, we shall take the liberty to transcribe. After clearly and properly distinguishing between those extraneous fossils which originate from organic bodies, that existed *before the formation of the present land,* and those which are the parts of *animals,* &c., that have lived on the *very same continents on which we now dwell,* our author proceeds to consider the latter under two classes—viz., those which are found in clefts and chasms, and which by the help of stalactitical concretions are often converted into stone—and those which occur in loose earth or soil, and which have not acquired a stony character. No decided line, it is observed, can be drawn between these classes with respect to their antiquity, as in many instances the objects of both appear to be coeval; but, in general, the remains found in loose earth &c., are to be accounted of later origin, than those inclosed in caves and chasms, as they are rarely preserved in a manner so well fitted for long continuance.

The fossil bones which belong to the first of these classes, "are generally found in the neighbourhood of limestone strata, and are either enveloped or *penetrated* by calcareous, or sometimes ferruginous matter." (v. *Impregnation* 4.) "Of this sort are the bones found in the rock of Gibraltar" (these retain the phosphoric acid, distinguishing the substance of the bones from the mineral matter, a carbonate of lime, with which they are impregnated) "and on the coast of Dalmatia. The latter are peculiarly marked for their number and the extent of the country over which they are scattered, leaving it doubtful whether they are the work of successive ages or of some sudden catastrophe that has assembled in one place, and overwhelmed with immediate destruction, a vast multitude of the inhabitants of the globe. These remains are found in the greatest abundance in the islands of Cherso and Osero; and always in what the Abbé Fortis calls an *ocreo-stalactitic earth.* The bones are remains. All these are found scarcely altered from

---

of various animals, concreted with fragments of marble and lime often in the state of mere splinters, the broken and confused relics in clefts and chasms of the *strata*. Sometimes human bones are said to be found in these confused masses."

"A very remarkable collection of bones in this state is found in the caves of Bayreuth in Franconia."—Some of these, however, it is properly remarked, occur without any stalactitical concretion, so that they belong strictly to the class of fossil bones *that have not acquired a stony character*.—We may add, that many, which are even invested with stony matter, exhibit no sign of mineral *impregnation* or *change*, and of course are merely in the state, to which the present note refers (*Privation*).

The fossil bones which belong to the other class, or those which are *not imbedded in stony concretions*, have been "found in all countries whatsoever, but always in the loose or travelled earth, and never in the genuine strata. Since the year 1696, when the attention of the curious was called to this subject, by the skeleton of an elephant dug up in Thuringia, and described by Tentzelius; there is hardly a country in Europe which has not afforded instances of the same kind. Fossil bones, particularly tusks and grinders of elephants, have been found in other places in Germany, in Poland, France, Italy, Britain, Ireland, and even Iceland. Two countries, however, afford them in greater abundance by far than any other part of the known world; namely, the plains of Siberia in the old continent, and the flat grounds on the banks of the Ohio in the new"——"The fossil bones found on the banks of the Ohio, resemble in many things those of Siberia; like them they are contained in the soil or alluvial earth, and never in the solid strata; like them too they are no otherwise changed from their natural state, than by being sometimes slightly calcined at the surface; they are also of great size, and in great numbers, being probably the remains of several different species."——"The extent of the tract, through which the Siberian fossil bones are scatthe living bodies,† except in the loss or privation of

---

tered, is a circumstance truly wonderful. Pallas assures us, that there is not a river of considerable size in all the north of Asia, from the Tanais, which runs into the Black Sea, to the Anadyr, which falls into the gulf of Kamtchatka, in the sides and bottoms of which bones of elephants and other large animals have not been found. This is especially the case where the rivers run in plains through gravel, sand, clay, &c.; among the mountains, the bones are rarely discovered." Playf. p. 458.

The most remarkable *conservatum*, however, that Siberia has yet produced, is that of the carcase of a rhinoceros, dug from the banks of the river Wilui.—The skeleton when found was covered with the hide; and in some parts considerable portions of the muscles and tendons still remained attached to the bones! This, undoubtedly, is to be considered as an example of *conservation* under simple *privation* (§ III. 1. 2.) effected by mere inclusion in mineral matter; for it appears, that neither an absolute chemical change, nor a penetration of mineral particles had taken place to prevent the decay of the fleshy parts, the application of heat being found necessary for that purpose, after the body had been exposed sometime to the action of the open air (v. Pallas Nov. Comment. Petrop. T. XVII. p. 386).

† The extraneous bodies inclosed in amber generally exhibit every appearance of recent subjects.—They are mostly *insects* of the smaller kinds, as ants, two-winged flies (*diptera*) small moths, &c. It has been remarked, that these are seldom specifically the same, as the insects of the country, in which the amber is discovered—small vegetable bodies are also found in this substance; but more rarely than those just mentioned.

Amber has been found in almost every country in Europe; but is most common in Prussia, where it occurs in loose detached masses, on the shores of the Baltic.—It is sometimes found imbedded also; generally at small depths, in alluvial tracts of sand, gravel, clay, &c. and is frequently accompanied by fossil wood.

their animal juices. *Vegetable* remains†† are also

Amber is undoubtedly of vegetable origin, and hence has been considered, by some authors, as an extraneous fossil itself.—But, by parity of reasoning, most bituminous and carbonaceous substances, and perhaps some earths, ought to be so classed, as in many instances, they equally appear to be the result of principles, that once existed in organized matter. It should be remembered, however, that it is not the *substance*, but the *organic form or structure*, which properly constitutes the essential character of an extraneous fossil: and when this form has been lost in the mineral kingdom, we conceive the matter once possessing it, as strictly to belong to the class of fossils usually styled *native*, as that, of which the origin cannot so well be traced.

Shells and other relics of the sea, differing from the recent subjects only in the want of the connecting animal gluten, are common in the *less ancient* and *modern strata* of marl, clay, chalk, sand, &c., in most parts of the known world; but are no where perhaps more frequent than in this country. Those of Hampshire have been particularly noticed, for the perfect state of preservation in which they occur, as well as for the great number of distinct species, collected together in the same tract. Both Woodward and Brander observe (v. Cat. Foss. T. I. part II. p. 93. et Hant. Foss. pref.) that the fossil shells, &c., of that county are found in the greatest abundance, and almost in their native state, the loss of colour excepted.—They appear to be most common in *Hordwell cliff*; but the stratum, in which they are imbedded, a bluish clay or marl covered by gravel and sand, extends quite across the *New Forest*, and wherever dug into, has been observed to contain the same sort of remains.

†† Trees and other vegetable bodies are frequently found buried in *recent* and *modern tracts*, without having undergone any actual *chemical change* in the composition of their substance. We have met with such in peat; particularly with the remains of oak, fir, and birch, which scarcely, in any visible quality, differed from the recent woods—no trace of bituminization or other change be-

found, differing from the recent subjects only in the change induced by a partial decomposition or decay.

---

ing apparent in them. These must be distinguished from similar bodies, in which the bituminous fermentation has commenced, as is the case in *most* of the vegetable remains in peat, &c.,—and from those, in which that process is in a more advanced state, and connected with carbonization, as in Bovey-coal and Suturbrand for instance.

Extensive, continued beds of unchanged vegetable matter, as well as detached trees, are also common. Those on the Lincolnshire coast, already noticed (note ††. p. 36.), consist of roots, stems, and leaves of trees and shrubs, intermixed with the remains of aquatic plants, &c. *Dr. Correa de Serra,* who has so accurately described the appearances of these fossil vegetables, observes, that the bark of the trees is generally as fresh as when growing: and that their trunks, though mostly in a decomposed or soft state, sometimes afford very *sound pieces of timber,* which the people of the country, use for œconomical purposes. The Doctor himself separated from this mass of vegetable matter *perfect leaves,* which he ascertained to be those of the *Ilex Aquifolium,* and others, which he supposed to belong to some species of *willow.* (Phil. Trans. 1799). The perfect preservation of such bodies seems to indicate, that no chemical combination, distinct from that existing in the recent leaves, had taken place, at least in the individuals thus ascertained. Wood, we know, under a certain degree of bituminization, or when carbonized, will retain the arrangement of its fibres in almost any situation; but leaves and other tender or succulent bodies generally lose their organic conformation, with the commencement of those processes; especially when the surrounding matter is of the same nature, and undergoing a similar change. This is evident in the formation of peat and Bovey-coal, which seldom exhibit the foliage of the plants or trees, from which they originate.

In most of these instances, the further decay of the *reliquium* and the consequent loss of its *form*, appear to be prevented merely by seclusion from the atmospheric air.†

3. Conversion (*Conversio*). The separation and loss of the more volatile principles of the original body are frequently followed by a total *change*, arising from a new combination,†† in those which remain, the substance thus produced being chemically distinct from, yet still retaining the *structure* of the recent subject.

Obs. The bodies most liable to this change are the *bones* of various animals; *shells, corals,&c.*, and the *ligneous* parts of plants and trees.

---

† The peculiar nature and state of the inclosing substance will doubtless sometimes conduce to the more effectual conservation of such bodies, even when no actual impregnation of mineral particles has taken place. Thus, the saline quality of the earth, in which the bones so frequent in America are mostly found, is supposed to have contributed to their preservation; and it is obvious, that the putrefaction of the flesh of the Rhinoceros above mentioned, could only have been prevented by the congelation of the soil, in which it was buried.

†† This must possess the *structure* of the original; otherwise not to be considered as an extraneous fossil. (v. Note †. p. 43.)

A *conversion* or chemical change, in the principles of organic matter, when it has become a subject of the fossil kingdom, must take place in process of time, in every instance; but the term here, is only applied to those bodies capable of preserving their internal fabric, under such spontaneous alteration.

Conservata that have undergone the process of *conversion*, occur in the same kind of *soils*, as those that have not suffered a chemical change (§ III. 2.).

The *substances* produced by the *conversion* of organic matter are chiefly three—namely, *carbonate of lime, charcoal* or *oxide of carbon*, and *bituminated substances*.

The *first, carbonate of lime*, or lime combined with carbonic acid, is found in most *conservata*, in which *calcareous earth* forms the basis or hardening principle—as in *bones, shells, corals*, &c.—The other principles, with which the calcareous earth was united in the recent state, having disappeared, and given place to the acid in question.†

---

† The composition of recent *bones* has been already noticed; that of *shells, corals*, the coverings of *echini*, and other marine calcareous bodies, differs not only in the nature of the hardening principle, (which in some is the same as in bone, *phosphate of lime*, in others, *carbonate of lime*, and, in many, a mixture of *both*, vide Hatchett. Phil. Trans. 1799. 1800.), but also in the state of the connecting *gluten*, as it presents itself in the form of a cartilaginous, horny, or membranaceous matter, variously combined with the calcareous particles. It will be often doubtful, therefore, except when the composition of the recent subject has been previously ascertained, whether the calcareous earth, constituting a *conservatum* of one of these bodies, exist in the same state as in the original, or under a different modification; and especially if a *carbonate*, whether the *carbonic acid* have or have not been derived from the surrounding minerals. To those who may deem the subject worthy of investigation, the following general statement, extracted from Mr. Hatchett's observations on testaceous substances, &c.

Oxide of carbon is common in vegetable *conser-*

---

will be acceptable. According to the experiments of this gentleman,

Shells, in substance, are either *porcellaneous* or of *nacre* (mother of pearl). The *porcellaneous* have an enamelled surface; and their texture is generally fibrous. They consist of *carbonate of lime* and a small proportion of *gluten*. Those of *nacre* have, generally, a rough exterior surface, and a stratified structure. They consist of a *membranaceous* substance hardened and intermixed (*stratum super stratum*) with a small portion of *carbonate of lime.*

Madrepores and *millepores* consist, also, of *carbonate of lime* cemented by *gluten*, or connected, in various ways, with a *membranaceous* substance, which appears to be merely a modification of *gluten.*

Tubipores are composed of *carbonate of lime* and a *membranaceous* substance.

Corallinæ and *Flustræ* hold, in some instances at least, *phosphate of lime*, in their composition, as well as the *corbonate*—the *membranaceous* part is in the same state, as that in the madrepores, &c.

Isides consist of a *cartilaginous* and *horny* substance regularly organized—The calcareous matter, principally *carbonate of lime*, sometimes mixed with the *phosphate.*

Gorgoniæ vary considerably in their composition. In general they consist of two parts; a *horny* substance, which forms the principle and interior portion of their stems, and a more friable or *cretaceous* matter, with which the foregoing is invested. The horny part contains *phosphate of lime*, but scarcely any *carbonate.*—The outer part, *carbonate*, with scarcely any trace of the *phosphate;* and is united with a *soft, membranaceous* substance.

Echini (their shells or crusts) are *carbonate of lime*, with a small mixture of the *phosphate*, cemented by *gluten.*

The *crustaceous covering of marine insects*, (*crabs, lobsters, &c.*) contain both *carbonate* and *phosphate of time*, but the first in the greatest proportion.

vata. *Carbon*, as a fixed principle, exists in recent vegetables, and forms the chief part of their ligneous substance. When buried in mineral matter, the dissipation of the principles, with which it was combined in the living plant, is followed by *oxidation*, and an *oxide of carbon*, † still retaining the arrangement of the original substance, is the result.

Bituminated vegetable substances, or vegetable matter under a certain *degree* of bituminization,†† are also common as conservata.

---

† Vegetable matter, in a state similar to that of *charcoal or burnt wood*, is frequent in the mineral kingdom.—It not only occurs in *recent* strata, but also in the *modern* and *less ancient*, when productive of coal. Some species of coal, indeed, appear to consist almost entirely of this substance. It is only, however, when it retains its vegetable texture or form, that it is to be ranked as an extraneous fossil.

†† We do not conceive it possible, that in *perfect bitumens*, the product of this process when complete, the texture of the original can be preserved, though the form sometimes may. (v. Bituminous Petrifactions.)

Vegetable matter, in the progress of a mineral change, is first deprived of its *mucilage*, *tannin*, and other principles *soluble in water*, *extract* excepted. In this state, the fossil is to be referred to those which have undergone a partial decomposition and loss (III. 2. *privation*), but not an absolute *conversion* (III.3.) or *chemical* change, of principles in the remaining matter. The vegetable, however, may now be distinguished from that, which has been subjected to a still less degree of change, by its ashes affording *no potash after combustion*. The next stage of the process appears to be the loss of the *extractive principle*; to which succeed the production of the less indurated *bitumens*, from the *resinous* part of

Bituminization, or the process by which vegetable matter is converted into bitumen, sometimes takes place under circumstances, which appear to prevent its completion.—The structure of the original is then preserved;—as in *wood* and other vegetable bodies found in *peat*, *Bovey-coal*, &c.

c. 4. IMPREGNATION (*Imbutio*). Under this process the *conservatum* is penetrated with mineral particles, which are *mechanically* † united with those of the organic body, that still retain their original structure.

Obs. Impregnation may take place in all organic matter pervious to *water*, the undoubted agent by

---

the matter, and that of the *oxide of carbon*, from the *ligneous*. After this, either the separation of the bituminous matter from the carbonic takes place (*wholly or in part*) leaving the latter in the state we find it in *Bovey coal*, and other varieties of bituminated and carbonized fossil wood; or a new combination is effected between the carbonic matter and the bitumen thus formed: by which means, the texture of the original body is completely destroyed, and every vestige of organization, for the most part, lost in the production of the more solid and compact bitumens, as Asphaltum, Jet, &c.—and the numerous varieties of *pit-coal*, into which the pure or simple bitumens naturally graduate. (For a number of most excellent observations on the formation of bituminous substances, the reader is referred to Mr. Hatchett's well known papers in the Philos. Trans. 1804, and the *Linnean*, v. IV.)

† Not *chemically*—in which *impregnated conservata* differ from such of the *converted*, as have had their change brought about by a *chemical union*, between the organized particles and principles derived from the surrounding minerals.

which the introduction of the mineral particles is effected.† The bodies impregnated are either such as, at the commencement of the process, were in their original state, or such as had previously been subjected to *privation* (III. 2.) or *conversion* (III. 3.)—Thus *bones* with and without the *phosphoric acid*, are found replete with mineral matter—also *shells*, *corals*, and other marine productions of the same class, more or less altered from their original nature.—*Wood* and other vegetable substances, either *carbonized*, or only slightly changed from their recent state, also occur penetrated in a similar manner.

Impregnated conservata are either *saline*, *metallic*,†† *earthy*, or *inflammable*.

B. 5. SUBSTITUTION (*Substitutio*). In this process only the *form* of the *original* is preserved; *mineral* or *inorganic* matter having taken place of that which was *organic*.

Mineral may be *substituted* in the place of *organic* matter, under, 1. *Redintegration*, or a *renewal* of

---

† *Impregnation* is the first stage of the process of *intromission*, under which the formation of *intrinsic petrifactions* is effected. According to the same view of the subject, *conversion* is the commencement of *transmutation*: and, we may add, that as in all instances, the total decay and removal of the organic body must precede *redintegration*, *privation* seems more particularly connected with this last mentioned mode of petrifaction than with either of the foregoing.

†† The metallic are most common in veins.

external form of the original, 2. *Intromission,* or the *introduction* of *mineral* particles into the organic body, so as to *assume* its *internal structure.* 3. *Transmutation,* or a total, *chemical change* in the *original matter* and its *texture,* the *external form* only *remaining.*†

a. 6. Redintegration (*Redintegratio*). In this *mode* substitution does not take place, until the *whole,* or some principle *part,* of the original is removed by putrefaction, &c. and an empty cavity left in the surrounding matrix, of the size and figure of destroyed substance——the cavity being afterwards filled with mineral matter, which receives, and thus *renews,* as in a mould, the *external form* of the organic body.

Obs. Petrifactions, formed in this manner, are common, particularly in stones with an *earthy* fracture, and in such as possess an open and granular structure.†

---

† In Redintegration the *form* of the organic body is *renewed*—
in Transmutation, *retained*—
in Intromission, *assumed.*

As the materials of the petrifactions, in ***transmutation***, are evidently derived from the ***original bodies***, it may be conceived, that this ***mode*** ought to rank under ***conservation*** (§. III. 1.); but we must once more observe, that principles which have existed in an organized state, are to be considered, when under a new combination, of as ***mineral***, if the original ***texture*** be lost in the change of substance. It is not the principles ***alone*** which distinguish ***organic*** from ***inorganic matter;*** but the ***principles combined with the organic structure*** · Fossil ***Carbon***, possessing the vegetable texture, is ***organic***, without it, ***mineral*** matter.

Mineral matter, dissolved in water percolating through strata of stone, &c., may be separated from its menstruum, either by *crystallization*, or simple *precipitation*; and hence, petrifactions by *redintegration* have a *sparry* or an *earthy* structure, according to the mode, in which the constituent substance has been deposited——crystallization producing sparry or crystalline stones (*foliated* of Werner's school) precipitation, those which possess the earthy fracture. Both processes, however, are frequently apparent in the same specimen, especially among testaceous *reliquia*;—the exterior parts of which often consist of very thin *layers* of *earthy* stone, while the interior and more general mass is *crystalline* —Petrifactions of this kind are sometimes hollow, and have the surface of the cavity set with regular crystals. In other instances, crystalline stones, as spars, &c. occupy the whole bulk of the petrifaction in a solid mass. Sometimes, however, spars, or other stones the result of crystallization, form only those parts of the specimen, which have immediately taken the external figure of the original, the interior part, if the petrifaction represent a hollow body, as a shell, &c., being filled with a *nucleus* † of earthy matter.

---

† Through means of which, the escape of the organic, and the subsequent infiltration of mineral particles, have been effected. The stones, however, in which petrifactions are lodged, are not always now open or porous: they frequently possess a comparatively close or compact texture. This is readily accounted for, when we consider, that the process, which fills the mould of the petrifaction, is also that, by which a superior degree of solidity may be induced in the surrounding matrix.——Mr. Kirwan observes, that the induration produced in stones, by infiltration, is more considerable than that, which is the effect of desiccation, as the minutest particles of bodies are conveyed by it into the smallest interstices. He adds, that such infiltration is not an imaginary process, as appears by an elegant observation of Mr. Werner's, viz., that where various strata of a different nature occur, the petrifactions that are found in the inferior, are frequently filled with the matter of the superior, instead of that of the stratum which contains them. v. Geolog. Essays p. 45. Also p. 128, where the induration of stones of a loose texture, by infiltration, is treated of more at large.

---

† *Nuclei*, or kernels, as they are sometimes called, are bodies of mineral matter, moulded while in a soft and plastic state, in the cavities of fossil shells, &c.

A *Nucleus* is said to be *invested*, when it occurs covered, either with the original body in which it was formed, or with mineral matter which has taken the form and place of such body——*bare*, when its covering has been destroyed by various natural operations.

Some authors regard *nuclei* as a proper and complete mode of petrifaction; and, taking the *mode* for the foundation of their arrangements, class and describe these bodies, separately from the fossils in which they have been moulded. If, however, the principle, which we shall endeavour to establish in the following pages, be admitted—*that one species of organic body can give but one real or permanent species of reliquium*—it will be evident, *nuclei* are not to be considered as distinct petrifactions. Indeed, were the separation now objected to followed up, each individual

b. 7. INTROMISSION *(Intromissio)*. In which substitution takes place during the removal of the organic particles—the mineral being gradually introduced into the animal or vegetable body,—supplying the place, and taking the form of the matter lost. By this mode, the *internal fabric*, as well as the *external figure*, of the original is preserved.

Obs. The change induced by *intromission* is usually supposed to have been carried on as follows—By *putrefaction* the principles of organic bodies are gradually liberated—If the putrid fermentation take place in an animal or vegetable substance, capable of retaining its form, after the commencement of the process, and to which water, holding mineral matter in solution, has free access,† the dissipation

---

species of fossil shell, or other like body, would in most instances furnish three separable species of *reliquia; i. e.* the *impression* of the external surface on the enclosing matrix, the *body itself*, petrified or in the state of a *conservatum*, and the *nucleus*, bearing the impression of the concave or interior form. *Nuclei*, therefore, we merely consider as appendages to the respective species they fill, or have filled—and, with the same principle in view, we take the external impression to be only a *part* of the *matrix*—(v. Soil. *matrix*, &c.)

† It is obvious, that *intromission* can only take place, in particular bodies; and that the change, effected by this process, will be more or less perfect, according to the circumstances, under which it is carried on. If, for instance, the original possess parts of such a perishable nature, as to lose their form with the commencement of *putrefaction*, no mineral representation of those parts will be produced—such is the case with the fleshy and succulent; the

of the organic, is followed by a deposition of mineral particles, which entering, by filtration, the tex-

---

harder and more durable alone giving their figure to the substituted matter. For these, as the *wood* in plants, the *bones* in animals, &c., preserve their general form, after their vascular structure has become, by partial decay, pervious to the infiltrating fluid;—indeed, until the fibrous and less perishable portions of their fabric are also destroyed; and then the mineral, deposited in the first stages of the process, acts as the mould to the subsequent impregnations. Again, although the original should preserve its form to the last, yet if it part with organic matter, faster than the surrounding waters can supply the deficiency with petrescent particles, either no petrifaction will be produced, or one that retains but slight vestiges of an organic structure.—On the other hand, if the water deposite mineral matter in great abundance, and the immersed body decay slowly, an *incrustation*, and not a petrifaction, will be the result.

The theory now proposed to account for the changes induced in organized bodies, by the process we have termed *intromission*, is nearly that, which has been adopted by Bergman, Kirwan, Walch, Daubenton, and most modern authors, who have written directly or indirectly on the subject of petrifactions. Another hypothesis, however, has lately appeared from the pen of the ingenious Mr. Parkinson, which may be thus briefly stated.——Disclaiming the idea of a mineral deposition *gradually* assuming the form and disposition of the organic particles, while their removal by putrefaction, &c., is taking place, this gentleman conceives, that, in general, no insinuation of stony matter will be effected, unless the original body be prepared to receive it, by the agency of bituminization. In this state, wood (the only substance to which Mr. Parkinson's theory has, as yet, been applied) is frequently found with little or no alteration in its texture, and yet so thoroughly pervaded with water, " that it may be discharged from it as from ture of the decaying body, assume the form and arrangement of the matter dispersed. The change,

---

a sponge".—The water, with which the bituminated substance is imbued, he supposes, in certain instances, to be saturated with earthy particles, which are finally consolidated by crystallization, at once infixing in the stony mass, thus formed, the undisturbed arrangement of the enclosed vegetable fibres. Mr. Parkinson supports this theory by the fact, that every kind of petrified wood yields, when submitted to chemical tests, traces of bituminized vegetable matter; and by observing, that the objections to the attempt of accounting for the lapidification of vegetable substances, by the process of substitution, are innumerable—"In what manner," he asks, "can it be supposed, that a line, smaller than a hair, extending from the centre of a piece of wood to its circumference, can have its original component parts taken away, and their places so exactly filled by earthy particles, merely deposited by water, as to preserve its continuity unbroken?" If, however, this should be imagined to be possible, in the instance of a single line, he will by no means admit it to be so, in the complicated system of lines, which the innumerable minute vessels and fibres of decayed wood present.——Nor can we, he thinks, on the hypothesis of substitution, account for the colour of the original being so exactly retained, as it is in many specimens of petrified wood.

Without entering into any regular defence of the principles we have adopted, or a refutation of those advanced by Mr. Parkinson, it will perhaps be sufficient to remark, that the theory of substitution, by *intromission*, does not necessarily require, as Mr. Parkinson seems to think with Fourcroy, "the complete destruction of the original matter, and the disappearance of whatever constituted its elements"—this, indeed, can scarcely ever be the case; nor do we understand it to be absolutely contended for, by those best informed on the subject. Bergman, on the contrary, expressly states, after describing the manner, in which stony matter thus commenced, is continued, under appropriate circumstances, by a reciprocal removal of organized,

---

is substituted in the place of an organic body, that "non tamen semper omnes corporum destructorum particulæ auferuntur, nam destillando haud raro tales expelli possunt, quæ organicorum naturam redolent." Med. de. Syst. Foss. p. 48. Hence, we find, that the fact advanced by Mr. Parkinson, viz, that organic matter still exists in petrifactions of the formation we are now considering, is by no means a new discovery, or one incompatible, at least in Bergman's opinion, with the theory of a gradual substitution. Indeed, how should it be so?—*Intromission* is merely an advancement in the process of a change, commenced by *impregnation* (III. 4,) and can seldom take place to such an extent, as to extrude every particle of the original body, from the composition of the mass, which is at last produced. It remains, therefore, only to be considered, 1. whether a *complete* petrifaction (that is, one in which no animal or vegetable matter can be discovered, except by the aid of a chemical test) owes its general structure to the original matter displaced; or, as Mr. Parkinson supposes, to that which still exists, involved in the substance of the stone—2. whether the original, previous to its impregnation, was or was not in a bituminated state—and, 3. how far the colour of the organic body may have operated in producing that of its mineral substitute.

In the first place, we must readily admit, that it is difficult to conceive the manner, in which the organic materials have been carried away, particle after particle, and those of a mineral origin substituted in their place, so as to take the form of every vessel and fibre of the destroyed body.—But, on the other hand, is the difficulty removed by the supposition, that a proportion of the original matter, scarcely discoverable by chemical means, can be diffused through a large mass of stone, so as to infix in every molecule, as in petrified wood, an organic structure?—We have now before us a specimen of silicified wood, the minutest particle of which, when examined with a glass and an infiltration of stony matter, until the original body is superseded by a complete petrifaction.

---

exhibits a ligneous conformation; yet the only evidence it yields of its origin, on a portion of it being submitted to distillation, is a *faint* empyreumatic smell. To render Mr. Parkinson's theory admissible, there ought to be, as has been most justly observed, a much greater quantity of inflammable matter contained in silicified wood, than is found actually to be the case; "for it is not conceivable that the materials of a few grains of carbonated hydrogen and a drop or two of empyreumatic acid should be capable of retaining the minute and intricate texture of a piece of wood." v. Akin's Ann. Rev. Vol. III. p. 305.

With respect to the state in which vegetable matter existed, previous to its mineralization, we perfectly agree with Mr. Parkinson, and conceive there can be little doubt, that the wood has been bituminized, at least in many instances, from which the petrifaction has received its structure. But, allowing this, we see no reason to reject the hypothesis of a gradual removal of the organic matter, during the substitution of the mineral particles. Bituminated substances, and even bitumen itself, though not liable to spontaneous alterations like recent vegetable bodies, are still susceptible of decomposition—a long maceration in water, aided by concurring circumstances, is known to bring about this change. (v. Hatchett. Linn. Trans. Vol. IV. p. 151.) Why may not, therefore, the disintegration of the particles of bituminated wood take place, even after its fibres have been surrounded, and its pores filled, by an infiltration of silicious matter? A body thus circumstanced is not impervious to water; and there seems to be no established fact to oppose the supposition, that, in process of time, the vacuities, made by the decay of the vegetable matter, would be filled by posterior impregnations of silex.

The difficulty of accounting for the colour of petrified woods, by the theory of a gradual substitution, would doubtless be great, were the petrifactions in question really coloured, according to

The substances, most subject to this mode of substitution, are *wood, corals,* and other bodies, whose texture is particularly porous——Petrifactions of *shells, leaves,* &c. are rarely the production of this process.

The matter of the petrifactions which are formed by *intromission,* is usually siliceous——calcareous

---

their originals; but this, in numberless instances, is evidently *not the case;* and, where the tint of the fossil actually resembles that of the recent subject, the agreement appears to be merely accidental, and not to depend on a retention of the original, colorific particles, as Mr. Parkinson seems to infer. We are not, however, disposed to deny, that a very small proportion of bituminous matter may give, in some cases, a tinct to the stone in which it is incorporated; but, that the general colour of the mass, when it resembles that of recent wood, is in reality derived from the same source, cannot, we think, be admitted. To this we may add, that the variety of shades and hues, by which the annual circles, the medullary insertions, and the whole ligneous structure, are marked, in the fossil, as distinctly, though not with the same colour, as in the original wood, is well accounted for by the theory of a gradual substitution; which supposes the softer or medullary fibres to decay, generally, faster than the more woody or durable, and that the latter infiltrations may differ materially from those of the matter deposited in the first stages of the process—and, of course, mark with a variety of tint the structure of the parts which they imitate.

On the whole, therefore, we see no reason to reject a theory so generally received, for that which Mr. Parkinson has endeavoured to introduce.—At the same time, we beg leave to state the great respect we entertain for that gentleman's chemical knowledge, as well as for his ingenuity displayed in the investigation of the present subject.

and argillaceous petrifactions seldom exhibit the internal texture of their originals.

c. 8. Transmutation (*Transmutatio*). In this mode, the *mineral matter*, substituted in the place of that which was organic, is produced by the resolution of the *organic body itself*——the dissipation of the aqueous and volatile particles, and the *loss of the original texture*, † being followed by a new combination in the remaining principles.——The substance, thus formed, *retaining* the *external* figure of the prototype, by the medium of the impression, made by the animal or vegetable, on the surrounding matrix.

Obs. A *transmutation*, or complete mineral change, may take place, both in animal and vegetable bodies, under various circumstances; but the *mode*, to which the term is now applied, requires, for its completion, the enclosure of the organic matter by a mineral substance, capable of receiving and retaining the impression of its external form. In this state, perfectly secluded from the atmospheric air,†† the enclosed body passes through various gradations of change, which, in the end, produce a mineral formation of matter, inflammable or earthy, according to the nature of the original, and the loss it may have sustained, of its constituent principles. In general, we find *transmutations* of vegetable bodies to yield *carbonaceous*, or *bituminous* substances: the animal *transmutations* are, for the most part, *calcareous*; sometimes, however, *bituminous*.

---

† This distinguishes petrifactions by *transmutation*, from *conservata* which have undergone the process of *conversion*. (v. 3.)

†† Vide note ††. p. 49. on the changes induced in vegetable matter, when in a fossil state.

Vegetable petrifactions, under this mode, differ, also, in some degree, with respect to the manner in which they retain the external form of their originals.——The mineral, resulting from the change, forming, in certain instances, only a thin film or covering to the mass, which constitutes the chief bulk of the petrifaction—as in the petrified *stems* of plants, &c. which frequently exhibit, in their structure, a *nucleus* of stone (similar to that of the matrix) thinly invested with a layer or coat of coaly matter.†——In petrified *leaves*, and other like bodies,[†] carbon or bitumen, the product of their change, generally constitutes the whole of the petrifaction, and entirely fills up the moulded impression of their form, on the inclosing stone. In some instances, in which we may suppose the *leaves*, &c. to have been of a particularly thin and delicate structure, the only vestige of the *transmutation* is the figure of the vegetable, delineated, as it were, by

---

† In describing some specimens of this kind, Mr. Parkinson has so well explained the mode of their formation, that we shall take the liberty of extracting a few lines from his ingenious work. "Plate III. Fig. 3. represents a fossil of this kind from Chepstow, in Monmouthshire. This, as well as most others of this kind, is little more than an impression, covered with a bituminous film, of a very inconsiderable thickness, *its internal part being entirely sand-stone*. The explanation of this circumstance does not, however, appear very difficult. The plant, having been surrounded by the soft or fluid materials, of which the sandstone has been since formed, its internal succulent part would soon waste away, and its place be filled with the soft magma; while the more solid and ligneous epidermis would remain, and, after a time, would give its correct impression to the surrounding lapidifying matter. *Then*

---

passing through the bituminous change, it would fill its own mould, with its own altered substance, forming such a surface, as the surrounding stony matter would adhere to but slightly; and would therefore dispose to that separation by which its form is displayed." (Organic Remains p. 433. vide, also, p. 431.)

[†] Frequently, but improperly, considered as mere impressions of leaves, &c. since an accurate investigation will generally discover the matter of the petrifactions adherent to what is really their impressions in the matrix.——In petrifactions of *fern*, the nodules of ironstone, in which these fossils are often inclosed, mostly split so as to exhibit, on one part, the plant itself petrified, on the other, its impression.

It may not be unnecessary to observe, in this place, that petrifactions of leaves are not always the production of a *transmutation* of the original vegetable matter.—We possess several specimens of petrified *fern*, in which not the least trace of a bituminous, or carbonaceous substance, is apparent.—The matter of the *substitution* being the same as that of the *matrix*, an *argillaceous iron-ore;* but separable from it, in form of a thin flake, which would possess, if it could be detached in a perfect state, the exact thickness, as well as the figure, of the original. Such specimens are evidently *casts*, and have been formed by *redintegration* (v. III. 6.), in the impressions on the matrix, left empty, for a time, by the decay and removal of the vegetable bodies.

a *bituminous stain,* on the substance of the matrix: scarcely any visible impression from the body, as originally inclosed, remaining.†

The animal bodies, which have undergone the mode of petrifaction we are now considering, are chiefly *shells* and *corals.*—The *shells* are always filled with a *nucleus* of earthy stone,†† of the same kind as that in which they are included: the substance of the petrifaction itself is mostly *calcarcous spar,* evidently the production of the original body, the organic texture of which has been wholly obliterated during its mineralization.††† Petrifactions of this kind, particularly those of *coral,* are frequently invested with very thin coverings of *chalky* matter; into which the original substance appears to have passed, while acquiring the *sparry* fracture. The remains of *fish,* as their bones, teeth, &c. have sometimes, also, been subjected to a sparry *transmutation*; but these are almost always found only partially changed: certain parts of them (particularly the exterior parts) still retaining their original substance and conformation.

---

† We have a beautiful example of this mode, in a specimen now in our hands, in which hardly any impression of the leaf (a *fern*) is discernible even with the help of a glass, although its general form and structure are most minutely marked, by a dark, staining, bituminous matter, incorporated, as it were, in the substance of the stone. Our specimen is in an indurated marl: Mr. Parkinson has described one of the same kind in gritstone. (v. Organic remains. pl. III. f. 5.)

†† The *nucleus* distinguishes shells which have undergone *transmutation,* from those *casts,* in which the whole mass of the petrifaction is *calcareous spar;* but, still, as the change effected by *redintegration* also admits of *nuclei,* it is sometimes difficult to determine the mode, in which the *sparry petrifaction* of a shell, with an *earthy nucleus,* has been formed.—In general, we conceive, that petrifactions of shells by *transmutation* will be found to have the calcareous spar, of which they consist, covered, more or less, with the chalky matter, above noticed.(p.65.).—In testaceous petrifactions by *redintegration,* nothing of the kind, we believe, is ever observable.

††† Professor Playfair has remarked, that the petrified shells and corals of limestone strata, though sparry, are often foliated and

The bituminous *transmutations,* furnished by the the animal kingdom, are, as already noticed, very

---

preserve their animal, in conjunction with their mineral texture. (v. Illustrations. p. 191.) If, by the animal texture, is here meant that peculiar grain, or disposition of the particles, which a recent shell exhibits on being broken, we must observe, that we have never yet seen this, in any calcareous petrifaction, really possessing the sparry or rhombic fracture—nor do we conceive it possible, that the fracture of spar and the grain of the original matter can exist together. We suppose, however, by the animal texture, Professor Playfair merely intends to distinguish that stratified or tunicated conformation, which certain bivalves possess; and which is frequently evident in them, after they have undergone the mineral change now referred to. This retention of the general structure of the original, is easily accounted for, by the supposition, that each layer or stratum has separately passed through the sparry transmutation; and of course, that each has preserved its form distinct, in some respect, from that of the other coats of the shell, to which it is attached. The same remark is also applicable to the petrified remains of the *entrochi* and other jointed zoophytes, which, though changed into spar, still retain the internal, articulated structure of their stems.

rare: petrified fish sometimes present a bituminous or coaly matter on their surface, which appears to have been produced by the substance of the parts, of which it retains the form.—And the epidermis or pellicle, which is found on some species of shells, also affords, in the fossil state, a thin film of bitumen, with which the petrified subjects are still covered.

TERMS,

distinctive of the *Reliquium,* according to its *mode.*

a) 9. CONSERVATED *(conservatum)* retaining the organic form under one or other of the modes of *conservation* (A. 1.)—not petrified.

10. Semi-recent † *(semi-recens)* conservated nearly in its recent state, the loss of substance excepted (v. 2. Privation)

11. Converted *(conversum)* conservated by *conversion* (b. 3.)

12. Impregnated *(imbutum)* conservated by *impregnation* (c. 4.)

b.) 13. PETRIFIED *(petrificatum)* retaining the organic form under one or other of the modes of *substitution* (B. 5.)

---

† It has not always been expedient, for obvious reasons, to form the *term,* discriminating the fossil by its *mode,* from that which has been applied to the *process* of the mode.—Hence, the present terms do not, in some instances, point out the *process,* but rather the *state,* of the mineral change.

14. Cast, or moulded *(redintegratum)* petrified by *redintegration*, (a. 6.) or the renewal of the external figure of the original, in the mould or concavity of the matrix.

15. Ingenerate *(ingeneratum)* produced by *intromission* (b. 7.) or the introduction of the mineral particles into the internal texture of the original.

16. Transmuted *(transmutatum)* petrified by *transmutation* (c. 8.) or a perfect mineral change in the original substance.

c.) 17. Compound †† (*compositum*) when two or more *modes* of change are discoverable in the same specimen, either in the *petrified* or *conservated* state.

18. Semi-petrified(*semi-petrificatum*)imperfectly petrified—some part of the *reliquium* remaining in the *conservated* state.

19. Doubly-petrified (*duplicato-petrificatum*) when two *modes* of *substitution* are distinctly apparent in the same specimen.

20. Doubly-conservated (*duplicato-conservatum*) when two *modes* of *conservation* are distinctly apparent in the same specimen.

[††] The *Compound petrified reliquia* are perhaps more common than those, which have been preserved by one simple mode of mineralization—among the *conservata*, also, various processes, or mixed modes of change, are frequently apparent, in the same specimen. (v. note † page 40).

d.) 21. Obducing† (*obducens*) when the matter of the *reliquium* is spread over the surface of a *spurious nucleus*. (27.)

22. Staining (*fucans*) when the matter of the *reliquium* is so incorporated with the matrix, that the form of the original is only marked by a stain, or difference of colour, locally imparted to the inclosing stone.

e.) 23. Nucleated (*nucleatum*) having an internal *nucleus*. (26. 27. &c.)

24. Empty (*vacuum*) without a *nucleus*, and hollow.

25. Solid, or full (*refertum*) neither hollow nor nucleated—of the same substance and structure throughout.

——the Nucleus is an appendant part of the *reliquium*. (v. note †. page 54.)

f.) 26. Genuine (*verus*) when moulded in a body which was hollow in the recent state (as a shell, &c.) The *genuine nuclei* always represent the *interior* form and marks of the original bodies, in which they have been formed.

27. Spurious (*spurius*) when moulded in a body which has become hollow by decay (as the stem of a plant, &c.) The *spurious nuclei* frequently

---

† The *obducing reliquia* are very common among the petrified *stems* of plants, which often exhibit the real substance of the petrifaction, as a mere covering to the mass of stone forming the *nucleus*. (v. page 62.)

present the *external* form of the bodies, from which they have been moulded.[†]

g.) 28. Invested (*vestitus*) covered by the *reliquium* in which it has been generated.

29. Bare (*nudus*) occuring without the *reliquium.*

h.) 30. Loose (*liber*) remaining in the *reliquium,* but not attached to it [††]—moveable in its cavity.

31. Fixed (*fixus*) not moveable; entirely filling the cavity of the *reliquium,* but yet distinct and separable from it.

32. Inseparable (*inseparabilis*) the substance of the *nucleus* passing gradually into that of the covering *reliquium,* so as not to be distinctly separable from it. [†††]

[†] This will not be difficult to explain in the *spurious nuclei* of vegetable bodies, to which these formations almost peculiarly belong. The external form and markings in the *stems* of plants, the *trunks* of trees, &c. are always continued *through* the *cuticle* or outer covering, and fixed in the cortex or exterior *bark.*—If, therefore, the substance of the vegetable. after being inclosed in stony matter, be gradually removed, till the decay reaches the cuticle, it is evident, the cavity then formed will impart to the matter, afterwards introduced into it, the external appearance of the original: and, that the cuticle, remaining either in a recent or changed state, and forming the true *reliquium,* will, in most cases, be attached to the surface of the nucleus thus generated.

[††] The matter of the nucleus having been contracted by desiccation.

[†††] This takes place in some vegetable petrifaction, in which the cavity, formed by the decay of the interior matter of the ori-

Form or Structure. (Forma.)

The *form* or *structure* of an extraneous fossil includes the whole of its configuration—

This it either *essential* or *accidental.*

A. 33. THE ESSENTIAL FORM (*Forma essentialis*) is the configuration received from that structure which distinguished the *original* organic body—and is either *external* or *internal.*

---

ginal, appears not to have reached the outer integument, nor to have remained empty for any considerable space of time, the stony substance of the *nucleus* having been introduced, seemingly, while the organic body was still in a soft and decaying state—And hence, the gradual incorporation of the native mineral matter with that of the original; and, of course, the want of that regular separation, which usually takes place between the *nucleus* and the inclosing *reliquium.*

As a conclusion to the remarks we have made on the *Modes* of extraneous fossils, it may not be improper to state those enumerated and defined by *Linnæus.*

" Petrificata quadruplici modo communiter evadunt:

1. *Fossilia* dicuntur Lithophyta aut Testacea, quæ diutius in terra latuere immutata, tantum ab elementis parum quasi calcinata, glutine orbata, sicciora, fragiliora, nec lapidi immersa.

2. *Redintegrata* sunt Petrificata, quorum Animalia cortice duriore obtecta, intra terram sepulta et arcte compressa, demum interiore præsertim substantia consumpta, reliquere cavitatem; quam replevit vel terra tenuissima ab aqua allata, aut crystallisatio, ut evaserit solida interne, externe vero servaverit propriam figuram.

a. 34. THE EXTERNAL ESSENT. F. (*Forma essent. externa*) exhibits the *figure* of the *original.*

b. 35. THE INTERNAL ESSENT. F. (*Forma essent. interna*) exhibits the *fabric* or *texture* of the *original.*

B. 36. THE ACCIDENTAL FORM (*Forma fortuita*) is the configuration imparted to the *reliquium* either by the *mineral substance,* with which it is combined, by the *mode* in which the *mineral change* has been effected, or by the peculiar *state* or *condition* of the original during its change.—Hence the *accidental* form is either 1. *mineral,* 2. *modal,* or 3. *conditional.*

a. 37. THE MINERAL ACCIDENT. F. (*Forma fort. mineralis*) is found in *petrifactions,* and includes both the external appearance and the internal structure, as far as either might have been possessed

---

3. ***Impressa*** sunt petrificata ex animalibus mollioribus, quæ sepulta et compressa intra terram reliquerunt figuram, sed tota consumta, ut typus tantum remanserit pristini animalis.

4. ***Transubstantiata*** sunt, quæ tam interiorem, quam exteriorem structuram in lapide ostendunt; orta ex durioribus, quæ diutius perstiterunt in terræ gremio." *Museum Tess.* p. 32. To the above are added, in the *Systema Naturæ* (Tom. III. p. 154. "*Incrustata,* more Stalactitæ, ab aqua calcaria, imprimis thermali——" Linnæus justly remarks, however, that these last are scarcely to be ranked as petrifactions.

With respect to the different modes of formation, in extraneous fossil bodies, as thus stated, we have to observe, that the *Redintegrata* and *Transubstantiata* can only be considered as genuine by the *mineral* matter of the petrifaction, if it had not been united to an extraneous form.

Obs. Thus, internally, petrifactions exhibit the *compact, foliated*, or *slaty* structure (*fracture.* Werner) according to the mineral disposition of the matter of which they are composed; and, externally, they have an *earthy, granular*, and, often, *drusy*, appearance, distinct from that which existed in the original body; and dependant on the particular *form* of the particles of the constituent substance.

b. 38. THE MODAL ACCIDENT. F. (*Forma fort. modalis*) is the peculiar structure or form which the *mode* (*Modus*. page. 39.) has imparted to the reliquium, so as to alter, or more or less conceal, that which belongs to the *prototype*.

Obs. Thus the *compressed* or *flattened* form, is often the consequence of the *mode* in which the mineral change has been brought about, and not the effect of a similar structure in the original.—Some *reliquia* retain the form only of one side, or of one half, of the organized body represented; while others present the whole of the external or internal organic fabric, according to the manner, in which the mineral matter has been united to the animal or vegetable figure.

---

petrifactions.—The *Fossilia* nearly answer to our *Reliquia*, and the *Impressa* and *Incrustata* properly belong to the *matrix* (v. SOIL. *Matrix*. &c.)

c. 39. **The conditional accident. f.** (*Forma fort. conditionalis*) is that modification of the organic form, which can have been received only from some particular state or circumstance, under which the original has existed, but which has not been essential to it as an organized body.

Obs. Hence, the loss of any part, in the original body, gives a *conditional form* to the *reliquium.* —Thus, the absence of one of the valves, in a bivalve shell—the decay of the ligneous matter in vegetables, imparting to the fossil subject a structure not essential to the recent wood—the want of the body, or head, of the animal, in the *entrochus*— as well as the expanded or contracted state of that part, in such specimens as possess it—are all circumstances, which produce *conditional forms,* in the respective *reliquia* afforded by those bodies.

Terms,

discriminating the *Reliquium,* according to its *form* and *structure.*

* *Essential Form.*

a.) 40. Animal (*Reliquium animale*) having an animal form.

41. Vegetable (*vegetabile*) having a vegetable form.

b.) 42. Intrinsic (*intrinsecum*) having the internal texture or fabric of the original.

43. Extrinsic (*extrinsecum*) bearing only the

external form of the original.

To these are to be added all the *terms* by which *form* and *structure* are distinguished in the *original*. (v. Prototype.)

* * *Accidental Form.*

a. Mineral,

depends on the structure of the mineral substitute, to which the *terms*, distinctive of such form, ought only to be applied.† (vide Substance.)

b. Modal.

44. Complanated (*complanatum*)†† flattened or compressed—reduced to a level or even surface during its fossil state or change.

---

† Thus we cannot, with propriety, or without a confusion of terms, say a *granular reliquium*, a *conchoidal reliquium*, &c. to distinguish the *mineral* form, as the same epithets may be used, in certain cases, to discriminate the fossil, according to the *essential* structure.

†† *Compressed* is the epithet usually applied to *reliquia* in this state; but, as the same word is employed, both in Botany and Zoology, to distinguish the form in all bodies, or their parts, with two opposite flat sides, it has been thought expedient, in the present instance, to adopt another term. By this means, a discrimination is established between the animal or vegetable fossils, that have received the *compressed* form from their originals, and those which have acquired it, during the process of their mineralization.

Complanated or *flattened reliquia* are very common—but are always confined to strata with a *slaty* structure. (v. note ††. p. 6.) It is observable, that the *complanation* or *flattening* of the extraneous fossil is constantly in a degree proportionate to the thinness

45. Half-shaped (*semiforme*)† retaining only one side, or half, of the external form and bulk of the original.

46. Complete, or full (*expletum*) retaining the full bulk of the original—neither *complanate* nor *half-shaped*.

c. Conditional,

or *accidental forms* arising either from the *deficiency* of some part of the original, or from the peculiar *state* in which it existed, at the time of its mineral change (v. p. 73.) can only be described by the same *terms*, as are employed to discriminate the circumstances in the recent subject, on which these *forms* depend.

Prototype. (Protypus.)

The *prototype* of an extraneous fossil is the *animal* or *vegetable* body (specifically considered) *represented* by that fossil.

---

of the laminæ of the inclosing stone; the same species approaching nearer to its genuine bulk or thickness, as the distances between the separations of the laminæ increase.

The *complanation* of organized bodies, after becoming subjects of the fossil kingdom, is a phenomenon by no means well accounted for. It appears, however, to depend, in some measure, on the softening of the animal or vegetable substance by long maceration in moisture, and the compressure of the inclosing stony matter, gradually indurating by contraction.

† Petrifactions, particularly of vegetables, frequently retain

——The *original* body (*C. originale*) is the individual from which the fossil has received its form. —Hence, the *original* is to the *prototype,* what the *individual* is to the *species.*

The *prototype* and the *original* are to be distinguished, 1. according to their *kind* (i.e. *class, genus,* or *species,* &c.) and, 2. according to the *part,* which has communicated their *form* to the *reliquium.*

a. Kind.

According to which the *prototype* is either an *animal* or a *vegetable.*

A. 47. ANIMALS (*Animalia*) giving form to *reliquia,* are *mammalia, birds, amphibia, fishes, insects* and *worms.*

---

only one side of the original form, the other being lost in the matter of the surrounding stone—so that the *stem,* or other vegetable body, appears as if it had been divided longitudinally into two parts, before its mineralization.—It may be somewhat difficult to explain the exact mode of formation, on which this appearance depends; but, we conceive it to be owing to the unequal hardening of the enclosing stratum—the lapidification of which has been sooner effected on one side of the organic body, than on the other.—Hence, the stone has retained the impression of that side of the vegetable, &c. on which it was first formed; while, on the other side, the decay of the organic body being previous to the consolidation of the mineral matter, the vegetable form has been lost, in the soft mass of the matrix, forced by compressure laterally into the concavity formed in the hardened part of the stone. In this process it is evident, as in other *nucleated* relics, more or less of the original matter may remain, and cover the surface of the petrifaction.

a. 48. **Mammalia** (*Mammalia*) are animals that are viviparous and suckle their young—(v. *Syst. Nat.* ed. Gmel. p. 12).

Obs. The remains of *mammalia* are not uncommon in the mineral kingdom, excepting as *petrifactions*, in which state they are to be considered as *very* rare. The different fossil *mammalia* that have hitherto been discovered, are, in general, those of a large kind, as Elephants, Rhinoceri, Whales, &c. Among these are many unknown species, or such as have not, as yet, been found in the recent state; particularly one of an immense size, which appears to have been a carnivorous animal—its remains are most common in North America, but have, also, been found in some parts of Europe.†

---

† For the *kinds* (*genera*) of mammalia, hitherto discovered in the fossil state, v. *Syst Arrangement.* p. 2.

In the *Report of the Transactions of the National Institute of France*, 1806, there are some very curious and interesting remarks by M. Cuvier, on the different *species* of this class, that have been distinctly ascertained to belong to the fossil kingdom, and that have not, as yet, been found living or in the recent state.—According to this celebrated anatomist, both the *elephant* and *rhinoceros*, whose remains have been found buried in every part of the known world, are perfectly distinct from the present living species.—There is a marked difference, in the structure of their skeletons, from those of the *elephant* and *rhinoceros* of the present day, and he concludes, that there can be no doubt that the animals, which furnished these relics, are now extinct.—To these he adds two species of Bears, found buried with the remains of the Tiger and other carnivorous animals, in the caverns of Germany; and at least

b. 49. **Birds** (*Aves*) are oviparous animals, having two legs, and two wings, and the body covered with feathers. (v. Syst. Nat. ed. Gmel. p. 233.)

Obs. The remains of *birds* are very scarce, if indeed they have been ever found, in the fossil state.—Such, however, are said to have been met with in limestone. (v. Werner's Extern. Char. by Weaver. p. 140.)

c. 50. **Amphibious animals** (*Amphibia*) breathe arbitrarily, through the mouth, by the means of lungs. Their heart has only one ventricle, and one auricle. (v. Syst. Nat. ed. Gmel. p. 1033.)

Obs. The *reliquia* that have received the form of *amphibious animals* are, also, rare; but the remains, considered as such, are much less doubtful, than those of the precedent class —It is but one order of the *amphibia*, however, namely the *reptilia*, that is

---

eight more species of non-descripts, whose bones have recently been discovered in the plaster quarries near Paris.—If, with these, we reckon the fossil species of *pecora*, that have been deemed, by their horns, to be distinct from any of that order now existing, we shall find the number of *mammalia*, either extinct, or remaining undiscovered, to be more considerable, than what naturalists in general have imagined.—We ought to observe, that M. Cuvier, in the report just referred to, appears decided in his opinion, that the *mammalia*, furnishing these remains, have lived in the places where their bones are found—and, that the deluge has not been the cause of their present accumulation and interment; as they exhibit none of those appearances of attrition, which necessarily would be found in such bodies, if they had been transported, from one country to another, by a general inundation.

found fossil.—The *serpentes* have not been discovered either in the petrified or conservated state.

Among the fossil *amphibia* are to be enumerated the remains of the *tortoise (Testudo)* found near Maestricht, and elsewhere; the petrifactions of *frogs* (*Ranæ*) said to have been discovered in the *swine-stone* of Oening, and the *lizards (Lacertæ)* of the bituminous-marlite of Mansfeld.—The supposed *crocodile* found near Whitby (Yorkshire) appears to have been the skeleton of a *Balæna.* (v. Camper. Phil. Trans. R.S. Vol. LXXVI. P. 1. p. 145.) And the other instances, in which that animal is stated to have been found petrified, are very questionable.†

d. 55. Fish (*Pisces*) are animals which breathe by the means of *gills*—their heart is furnished with one ventricle and one auricle. (v. Syst. Nat. ed. Gmel. p. 1126.)

Obs. The fossil remains of the animals of this *class* are numerous—each of its *orders,*†† and many of the *genera* ††† in each order, affording subjects for the mineral kingdom—many of these are known as living species; particularly the petrifactions of fresh-water fish.—The originals of those, which are supposed to have been sea fish, have been ascertained, also, in a few instances; but a far greater number of them appears to belong to unknown species.

---

† The *crocodile*, said by Whitehurst to be discovered in Derbyshire, was nothing more, we have every reason to suppose, than a particularly large species of *orthoceratites*. (v. Derby. Petr. pl.39.)

†† Which are six according to Gmelin—Apodes, Jugulares, Thoracici, Abdominales, Branchiostegi, and Chondropterygii.—The last two form the *Amphibia Nantes* in the 12th. Ed. of the Sys. Naturæ.

††† For the *genera* of fish furnishing *reliquia*, v. Syst. Arrangement, P. 2.

The state, in which these remains occur, is very various.—Sometimes the petrifactions exhibit the complete external appearance of their original, as those found in *Thuringia,* in a bituminous-marlite; at other times, the mere skeletons of the fish remain, as in those which are commonly met with in the slaty limestone of *Monte Bolca, Pappenheim,* and elsewhere: more frequently, however, nothing but the detached bones are preserved, as the vertebræ, teeth, &c.—These last generally abound in chalk and marl strata.

e. 53. Insects (*Insecta*) are animals furnished with *antennæ.*—They breathe through lateral spiracles, and have six, or more, legs—They are also distinguished from the next class by undergoing various transformations, before they acquire their last or perfect form. (v. Syst. Nat. Gmel. p. 1517.)

Obs. Insects may be divided into those which have, and those which have not, wings.—Of the first division, no species have yet occurred in the fossil kingdom, at least in their perfect or complete form, † except such as are enveloped with amber: the *larvæ* of the dragon-fly (*Libellula*) and of the water-scorpion (*Nepa*) are, however, said to be found in the *Oening* limestone. (v. Werner's Extern. Char. p. 142.)—Of the second division, i. e. of insects without wings (Order *Aptera*, Linn.) there are several species found petrified, belonging to the genera *Cancer*, *Monoculus*, and *Oniscus*.†

---

† We are aware of the *petrified Beetle* (*Entomolithus coleoptri*) noticed by *Linné*, in the *Museum Tessinianum;* but suppose, the fossil, on more minute examination, proved to be the *reliquium* of some-

f. 54. Worms (*Vermes*) are furnished with *tentacula*—have no proper or distinct head, nor legs; do not undergo any metamorphosis. (v. Syst. Nat. ed. Gmel. p. 3021.)

Obs. It is from this class that the animal petrifactions, properly so called, principally derive their form.

The Vermes are divided by Gmelin into five orders; †† viz. *Intestina, Mollusca, Testacea, Zoo-*

---

other body, as he has not enumerated it among the *Entomolithi*, in his last edition of the *systema naturæ*.——The fossil *Butterflies*, and and other winged insects, described by some authors, are doubtless nothing more than imperfect vegetable remains—as are, also, the supposed delineations of *Beetles*, &c. on shale, mentioned by Richardson in a letter to Lhwyd. (v. Lithoph. Brit. Luidii. p. 112.)

† Vide Syst. Arrangement, p. 2.

†† The orders, as they stand in the 12 Ed. of the Syst. Nat. are *Intestina, Mollusca, Testacea, Lithophyta*, and *Zoophyta*—Gmelin has united the Lithophyta with the Zoophyta; but has separated, from the Linnean *Zoophyta*, all those *animalcula* which are found in vegetable infusions, &c.—forming them, after the manner of Muller, into a distinct order, under the title of Infuso-

phyta and *Infusória*. The first and last of these orders are not found in the fossil state.—The second affords many beautiful petrifactions, chiefly from the genus *Echinus*.—Of the third and fourth order, nearly all the genera[†] have been discovered in the mineral kingdom; and the various species, from these genera, form the principal part of every collection of extraneous fossils.

The shells, zoophytes, &c. found fossil, particularly the petrified, are most commonly of species at present unknown in the recent state.[††]

The fossil *Vermes* are found in all substances, in which other *reliquia* occur, but are most abundant in calcareous strata.[†††]

B. 55. VEGETABLES (*Vegetabilia*) are divided by Linnæus into seven families—namely, *Funguses, Flags, Mosses, Ferns, Grasses, Palms*, and *Plants*. (v.Philos.Bot.p.37.)[††††]

a. 56. Funguses (*Fungi*) are vegetables of the

---

ria. Hence, the number of the orders, in this class, is the same in both editions of the *Syst. Nat.* now referred to, though the principles of the arrangement differ.

[†] For the different genera of *shells* and *zoophyta* found fossil vide Syst. Arrangement, p. 2.

[††] Vide page 10 and 11. note †††† and †. &c.

[†††] Vide page 7. o. and r.

[††††] Our reason for not enumerating, in this place, the *classes* and *orders* of plants, according to the Linnean Sexual System, will be found in our observations on the formation of the *genera* and *families* of extraneous fossils.

most simple structure.—have no distinct leaves or stem.†—"generally of a fleshy or cork-like substance, and of short duration. The *fructifications* disposed in *gills, tubes,* &c." (v. Hull's Introd. Linn. Syst. p. xlix.)

Obs. Fungi are not found in the fossil state.††

b. 57. Flags (*Algæ*) vegetables "of a gelatinous, membranous, coriaceous, filamentous, or crustaceous substance, and, for the most part, having no distinct root, leaves, or stem. The *fructifications* are various, as *capsules, tubercles,* &c." (v. Hull's Introduct. Linn. Syst. p. xlix.)

---

† What is usually considered as the *stem* in funguses is denominated the stipe (*stipes*) by *Linnæus.*

†† The *fungites* of authors are simple *madrepores* in the petrified state. v. Syst. Arrangement, P. 2. *Erismatolithus.*

Ferber, in his letters to *Baron Born*, mentions several petrified *funguses*, as they were supposed to be, which he observed in different collections in Italy.—Some of these, according to his opinion, were undoubted *Boleti.*—Without adverting to the impossibility of vegetable bodies, of such a perishable nature, having given their form to petrifactions, it may be observed, that *corals* sometimes affect the structure of *fungi* so completely, that they have frequently been mistaken for such, when petrified. We lately met with a specimen of fossil *Millepore* coral, which, in its general figure, as well as in the structure and disposition of its pores, so perfectly imitated a *Boletus*, that it was not till after repeated examinations, we were able to ascertain its real nature.—In a cursory view of collections such as a Tour usually affords, we think it not impossible, therefore, but that a naturalist even of Ferber's superior information may have been misled by the deceptive appearance of specimens of this kind, and the *names* imposed on them by their possessors.

Obs. They are very rare in the mineral kingdom —not more than two or three species of *reliquia* haveing, as yet, been observed, that may without hesitation be referred to this tribe of vegetables.†—Those that have been described appear to be marine plants, and are probably *fuci*. They occur in calcareous strata.

c. 58. **Mosses** (*Musci*) have "*capsules* enveloped in a *calyptre*, and reticulated membranous leaves, which, after being dried, are revived by the application of water." (v. Hull's Introduct. Linn. Syst. xlix.)

Obs. As rare, perhaps, as the *algæ*, in the petrified state. A few, however, have been found in argillaceous strata, with other vegetable relics. They occur also, as *conservata*, now and then, in *amber*: and, frequently, in the banks of certain rivers, enveloped by calcareous depositions.

d. 59. **Ferns** (*Filices*) have "their fructifications in spikes, or in *dots, lines*, &c., on the back or margin of their leaves; or at the root." (v. Hull's Introduct. Linn. Syst. p. xlix.)

Obs. This tribe or family of plants furnishes by far the most beautiful, as well as the most perfect, vegetable petrifactions that occur. The original species, with very few exceptions, are unknown.—

---

† One, the original of which appears to be the *fucus vesiculosus*, has been found in marl, along with shells and other marine bodies,

The fossils are almost always found in argillaceous strata, productive of coal and ironstone.

e. 60. Grasses (*Gramina*) are furnished with very simple or undivided leaves, a hollow, jointed stem or *culm,* and a glumose *calyx:* the *seed* is single. (Phil. Bot. p. 37.)

Obs. This tribe gives form, also, to many petrifactions; but they are rarely in a perfect state.—They are, in a great measure, confined to argillaceous strata.—The species are unknown as recent plants; but, in general, appear to have been allied to the canes and reeds indigenous to the Indies.

f. 61. Palms (*Palmæ*) have a simple stem (*caudex*) frondose at the top, and their fructification on a *spadix,* proceeding from a *spathe.* (v. Phil. Bot. p. 37.)

Obs. Petrified fruits, apparently from species belonging to the genera of *Cocos* and *Areca,* have been found in argillaceous strata, with other vegetable remains.

g. 62. Plants (*Plantæ*) include all vegetables not referrible to the foregoing tribes—and are either *Herbs, Shrubs,* or *Trees.* (v. Phil. Bot. p. 37.)

Herbs are such plants as perish annually down to the root.

Shrubs have several permanent woody stems, dividing from the bottom.

Trees have only a single permanent woody trunk.†

---

† These distinctions are according to the common acceptation of the terms Herbs, Shrubs, and Trees.—Linnæus makes the dif-

Obs. Fossil *plants* are more common, considered as a distinct tribe, than the remains from the preceeding families; but are rarely found in as perfect a state.—Trees and shrubs seldom preserve their foliage when petrified; and among the *conservata*, the leaves of trees, &c., are generally detached from the stems.

The petrified wood of trees is commonly found in *very recent seats* (v. Soil, seat, &c.)—Their leaves sometimes occur in *modern*, calcareous tracts. Petrified *plants* in general, however, are most frequent in *argillaceous* beds, with other vegetable *reliquia*.

b. Parts

represented by *reliquia* are either *animal* or *vegetable*.

A. 63. THE ANIMAL PARTS (*Partes animalium.*) are either *innate* or *fabricated*.

a. 64. Innate animal p. (*Partes animal. innatæ*) are those parts of the body that have been produced independently of any effort of the animal—and are either external or internal.

Obs. Among the *innate parts* of animals, the *bones* are the principal *internal* ones, that give their form to extraneous fossils—these constitute the *skeleton*, which is peculiar to the four first classes of animals.

---

erence between them to consist in the mode of budding, or in the want of buds—but observes, that with respect to trees and shrubs, nature has placed no limits between them, except in the opinion of the vulgar.

The *bones* of land-animals (including their *teeth, horns,* &c.) are rarely found in the petrified state, and never at any great depth, or forming, as it were, constituent parts of the solid strata.—But, for the most part, are mere *conservata,* loosely deposited in alluvial tracts, or in caverns and fissures.† The *bones* of the *amphibia,* and of the aquatic *mammalia,* (as the *seals,* Phocæ, and the *whales,* Cete.) are sometimes found petrified; but more commonly as *conservata*: these are usually lodged in *recent* strata (v. Soil. &c.). The *bones* of fish are either hard and spinous, or cartilaginous and soft-pointed—those of the first kind occur both petrified and conservated, in *modern* and *less ancient* tracts—the bones of cartilaginous fish, their teeth excepted, very rarely preserve their form in the fossil state.

The various *external* parts of animals, to be considered as innate, and which are capable of giving their form to *reliquia,* are principally the *scales* and *fins* of fish, the *horny covering* in some of the *amphibia* (the *testudines*) and the *integument* which incloses the whole of the body in insects: most of these are found in the petrified state, in the *modern* and *less ancient* strata. (v. Soil. &c.)—Every part of the *body,* as well internal as external, of certain crustaceous worms, is found, also, in the petrified state, and incorporated with the solid rock, in the *most ancient* of the *secondary* strata.

---

† Vide page 12. note ††. &c.

b. 65. **Fabricated animal P.** (*Partes animal. fabricatæ*) are parts superadded to the body by some voluntary? effort of the animal.—These are *shells* and *fulciments*.

Shells are hard, calcareous, moveable coverings, formed by an external apposition of matter,† secreted by the inclosed animal.

Shells are peculiar to certain genera of *vermes*.—In respect to their general structure, shells are either *multivalves*, *bivalves*, or *univalves*.††

Fulciments††† are immoveable, calcareous or membranaceous *props* or *supports*, formed, also, by an apposition of matter, secreted by different species of zoophytes.††††—Fulciments are always fixed by the base to some other body, from which they are extended in various forms, more or less plant-like.

In structure, fulciments are *solid* or *cellular*—The solid, when recent, are *internal*, being surrounded by the zoophytes which fabricate them—the cellular are *external*, and enclose the animals by which they are formed.

---

† Vide page 47. note †.

†† For an explanation of these and other *terms*, see the end of this section.

††† We have adopted this *term* as a general one, to distinguish all plant-like bodies formed by the *Zoophyta*, as habitations or supports; and which, according to their consistence, are denominated *coral*, *coralline*, *sponge*, &c.

†††† Fulciments are not innate bodies, although essential to the existence of the worms they support.—Like shells, they are gradually produced by a deposition of calcareous and membranaceous matter, exuded by the animal inhabitants.

Obs. The *fabricated parts* of animals are those which are most common in the fossil state, both as petrifactions and conservata.—The petrified abound in *ancient calcareous* tracts: the conservated in the *less ancient* and *modern*. (v. SOIL. &c.)

B. 66. THE VEGETABLE PARTS (*Partes vegetabilium*) are such as belong either to the *substance* of the plant, or to its *external form* and *structure*.

a. 67. THE SUBSTANCE OF A VEGETABLE (*Substantia vegetab.*) consists of the *cuticle*, *outer bark*, *inner bark*, *wood*, and *pith*. The cuticle (*epidermis*) covers the outer bark (*cortex*) from which is deposited the inner bark (*liber*).—This last changes gradually into hard rings of wood (*lignum*) surrounding the pith (*medulla*).

Obs. Of these the *cuticle*, *outer-bark*, and *wood*, are most frequent in the fossil state: the *inner bark* and *pith* are rarely, if ever, to be traced either in *conservata* or *petrifactions*. The *cuticle* is often evident, in the form of a pellicle, bituminated or carbonized, coating the stone or other mineral, under the vegetable figure; but, it is the *outer bark* that gives its structure, in most instances, to the body of the petrifaction; at least, if the internal texture of the original be wanting—when that is present, it is generally the *wood* of the plant, which forms the *reliquium*.

Wood is found in every state of mineralization, from the complete petrifaction to that, in which the original substance remains almost unchanged. It occurs mostly in alluvial tracts and other *modern* strata; also in water; sometimes in veins and fissures; very rarely in the *less ancient* of the secondary strata; but never in the *more ancient* (v. Soil.)†

The other vegetable *substances*, which preserve their form in *reliquia*, of course are frequently found, where the remains of the *external parts* of vegetables are also common—i. e. in the argillaceous strata of *less ancient* tracts productive of coal. —(v. 59.)

b. 68. The external parts of vegetables (*Partes vegetabilium extern.*) may be divided into the *root*, *trunk* or *stem*, *leaves*, *fulcres*, and *fructification*.—The *root* (*radix*) is the part which nourishes the plant, and from which the trunk or stem is produced.—The *stem (truncus)* is the part which multiplies the plant; or produces the leaves and fructification.—The *leaves (folia)* are the parts appropriated to respiration.—The *fructification (fructificatio)* is a temporary part for the purpose of generation—and the *fulcres (fulcra)* are parts which support or defend the plant.†

---

† At least, never as a constituent, or an imbedded part, of such strata.

The most singular situation in which petrified wood has been found, is that in New South Wales,—described by Mr. Collins as a small, sandy tract, a considerable height above the level of the sea, covered with the scattered, broken branches of dead trees, and what appear to have been their stumps and roots, still sticking in the ground, but changed to a brittle kind of calcareous stone.

The sandy deserts of Egypt, and of some other countries, also afford petrified wood, which seems to have been the remains of trees, once growing in those situations.

Obs. The *external parts* of vegetables most common in the fossil state are the *leaves* and *stem.*—The *root, fulcres,* and *fructification* are rare in the mineral kingdom.††

TERMS,

distinguishing the *reliquium* according to its *prototype* or *original.*

* *Kind.*

The *terms* applied to the *reliquium* to discriminate it, by the *kind* of organic body represented, are formed with a reference to the *name,* by which the *prototype* itself is distinguished; as a.) 60. Mammodolithus——a fossil or petrified *Mammal.*

---

† The primary parts of a plant, according to *Linnæus,* are the 1. *Root,* 2. *Herb,* 3. *Fructification.*—The herb comprehends the *leaves, stem, fulcres,* and *hybernacle.*—The fructification contains the *calyx, corolla, stamens, pistil, pericarp, seed,* and *receptacle.*

†† *Succulent roots* are not found in the fossil state.

61. Ornitholithus——a fossil or petrified *Avis.*

62. Amphibiolithus——a fossil or petrified *Amphibium.* &c., &c.

b.) 63. Anomites——a fossil or petrified *Anomia.*

64. Echinites———————— *Echinus.* &c. &c. (v. §. VI.)

** *Part.*

The *terms* distinguishing the *reliquium* according to the *part* represented, are such as relate to

a. *Animal parts;* and

1. The innate; as

a.) 65. Ossal (*reliquium ossale*) deriving its form from the *bones* or internal skeleton of the original; this may be

66. Vertebral (*vertebrale*) belonging to the *vertebræ.*

67. Dental (*dentale*) belonging to the *teeth.*

68. Costal (*costale*) belonging to the *ribs,* &c., &c.

b.) 69. Integumental (*integumentale*) a reliquium taking its form from the *integument* or

---

† *Ossal, testal,* &c. belonging to *bones, shells,* &c.—For the terms *osseous, testaceous,* &c. vide article *substance,* of the present section.

†† A general knowledge of *comparative anatomy,* as far at it respects *vertebral* animals, and the *terms* &c. by which the *bones* are distinguished, will be found indispensably requisite to the study of extraneous fossil.—For this the works of Cheselden, Hunter, Home, Cuvier, &c. are to be consulted.

external covering of the original; this may be

70. Squamal (*squamale*) belonging to the *scales,* as in petrified *fish* and *amphibia*—

71. Crustal (*crustale*) belonging to the *crust;* as in petrified *insects*† and *echini;*†† &c. &c.

---

† In insects, the external crust or covering is considered, by anatomist, as analogous to the bones, in the higher classes of animals.

†† The covering of the *Echinus* may be divided into the *crust* and its *appendices.*

The Crust (*crusta*) is the hard, calcareous, bone-like integument, in which the animal is enveloped.—Its surface is generally covered with tubercles, to which are articulated moveable spines of various shapes and sizes.

a.)Mouth (*os*) the aperture of the *crust* through which the inclosed animal takes its food.—It is quinquevalve, and always situate in the *base* of the shell.

Vent (*anus*) the aperture through which the excrements of the animal are passed. Its situation is various, being more or less distant from the mouth.—It is freqently closed by a kind of operculum or lid; and hence is not always visible in the fossil subject.

b.)Base (*basis*) the bottom part of the *crust,* in which the aperture of the *mouth* is placed.

Apex (*apex*) the top of the crust, opposite to the mouth.

Ambit (*ambitus*) the outline of the crust when placed on its base, and viewed from the top.

Margin (*margo*) the edge formed by the crust's taking a compressed or flattened shape.——This is *whole, dentate, sinuate,* &c. according to the species.

c.)Pores (*pori*) innumerable minute holes with which the shell is regularly perforated.—These are of two kinds.—Through the one, slender and almost imperceptible ligaments and fibres pass, by which the spines are attached to the tubercles, and rendered moveable at the will of the animal—through the other, the *tentacula* of the animal are occasionally protruded. (v. *ambulacra.*)

Foramina (*foramina*) apertures distinct from those of the *mouth* and *vent*, and only present in some certain species. —In the compressed or flat *echini* they are often large pervious holes, formed by the local coalescence of the opposite sides of the shell—their number varies from two to six.

Sutures (*suturæ*) are the lines which mark the juncture of one part of the shell with another part—the crust being composed of many pieces, joined or articulated together—the *sutures* are *dentate*, *serrate*, &c.

d.) Ambulacra (*ambulacra*) lines consisting of two or more series of pores, disposed in regular forms, so as to divide the surface of the shell into compartments or *areas*.

Areas (*areæ*) the parts which lie between the *ambulacra*. These two last terms have been adopted by *Linnæus*, with a reference to the supposed resemblance between the surface of the shell and a garden, divided by *walks* into *beds* or *areas*. The number and disposition of the ambulacra and areas afford the leading specific characters of the greater part of the *echini*.

The APPENDICES (*appendices*) are parts attached to the *crust:* these are the *spines* and *teeth* of the *echinus*.

a.) Spines (*spinæ*) long, hard, moveable bodies, affixed by one end to the surface of the crust—They vary greatly in number and shape—are frequently marked with *tubercles* and *lines* —are *obtuse* or *pointed; fusiform, subulate, clavate,* &c. &c. On the death of the enclosed animal they usually as in some petrifactions of *fish* and *vermes*, &c.†

2. The fabricate; as

---

fall from the shell, and hence are rarely found attached to it in the fossil subjecs.

The petrified spines (*lapides judaici* of authors) differ considerably in their form, from those of the known living animals —and hence Linnæus supposed these fossils not to have been the spines of *echini*—that they are so, however, is now placed beyond doubt, as some of the most singular in structure have been discovered, affixed to the crust, as in the recent state.

b.)Teeth (*dentes*) five, small, oblong, moveable bones, articulated to the same number of internal processes, placed perpendicularly round the aperture of the mouth.

The teeth are often found in the fossil state detached from the shell.

We have given the above definitions of the parts of an *echinus*, as we do not find them explained in any work to which we have, at present, an opportunity of referring.

† The terms, applied by *Linneus* to the external parts of animals, should be carefully studied by those, who wish to gain a knowledge of extraneous fossils, or communicate their observations on these bodies to others. To such the "*Enchiridion Hist. Nat.*" of Forster may be recommended as an excellent publication; but, we must observe, its usefulness would have been much increased, if the author had extended his plan through all the classes of the animal kingdom. Since the present work went to the press, we have seen "*Elements of Natural History*" published at Edinburgh, in which, lists of the Linnæan zoological terms, with very correct definitions, are given; so as to supply, in a great measure, those deficiences noted in Forster.

The following are a few terms which either do not occur in the Linnæan writings, or not exactly in the sense, in which we have

73. **Testal** (*testale*) a reliquium deriving its form from a *shell*; † and

---

employed them.—(v. Derbyshire Petrif.) They will be found necessary, in discriminating the *external parts* of the body in certain fossil zoophytes.

Stipe (*stipes*) the elongated appendage to the body of the zoophyte, by which it is frequently (not always) affixed to stones, rocks, and other substances—as in *Hydra, Vorticella, &c.*

Linnæus calls this part *stirps*, a term he also applies to the membranaceous, horny, and fibrous supports, fabricated by the *Gorgonia, Isis, Flustra,* &c.—By Gmelin the term is further extended to the stony matter or *coral,* deposited by the *Lythophyta* of Linnæus, and in this sense we have retained it. —But the fleshy stem in *Hydra,* &c. as well as the crustaceous one in the genus *Stylastrum* (v. Note on the *Stylastrum,* §. V.) is an innate part of the animal, and perfectly distinct in its nature from the fabricated props or *fulciments*; whether solid, as in *Gorgonia, Isis,* &c. or cavernous, as in those belonging to the *Madreporæ, Tubiporæ,* &c.——We have, therefore, deemed it expedient to mark the distinction by appropriate terms.

Disk (*discus*) in an articulated *stipe*, the internal part or surface by which one joint is united to another.

Ambit (*ambitus*) the surrounding, external surface of each joint of the *stipe.*

Branches (*rami*) are the lateral arms proceeding from the stipe (not from the body) of the zoophyte.

† The terms used in discriminating *shells* are very numerous: for their explanation we refer the reader to the "*Fundamenta Testaceologiæ,*" given in the "*Amœnitates Academicæ;*" and to the work above mentioned, viz., *Elements of Natural History.*—The following imperfect list of testaceological terms is introduced here, merely to note a few, we have found it necessary to add to

74. **Fulcimental** (*fulcimentale*) a reliquium deriving its form from a *fulciment* (v. page 102. Note †.)

---

those already in use—the structure of some fossil shells varying considerably from that of the recent kinds, even of the same genus—particularly in the *anomiæ* and *nautili.*

Shell: (*Testa.*)

MULTIVALVE (*multivalvis*) consisting of more pieces or valves than two.

BIVALVE (*bivalvis*) consisting of two pieces or valves.

Hinge (*cardo*) the joint on which the valves move in opening and shutting.

We consider it as including the *inferior margin,* or that edge of the shell which lies between the *beaks*—the *ligament* (*hymen. Linn.*) or the membrane connecting the valves, and covering the *anterior chink* (*rima anterior. Linn.*)—the *posterior part* (*anus. Linn.*) of the shell, immediately behind the beaks, and which often takes a depressed or concave form—and the *teeth* (*dentes*) or eminences with which the inner surface of the hinge is set.

a.) Compact (*coarctatus*) close or pressed together between the beaks—not externally flat or spreading. The hinge in most shells is *compact:* the term is used in describing the *anomitæ* and *arcitæ,* in opposition to *patulous.*

Patulous (*patulus*) externally flat and broad between the beaks; as in certain *anomitæ,* &c.

b.) Extended (*extentus*) long; running the whole length of the shell; as in *solenitæ,* many of the *anomitæ,* &c. (*cardo longitudinalis. Linn.*)

Short (*curtus*) not extended.

c.) Straight (*rectus*) forming a straight line. (*basis transversa. L.*)

Curved (*curvus*) bent; inclining more or less from a straight line.

d.) Cut (*sectus*) divided, in the larger valve, by a slit or narrow opening, which forms, when the valves are united, a triangular *foramen,* between the beaks; as in many of the straight-hinged *anomitæ,* &c.

b. *Vegetable parts*; and
1. Those of the substance; as

Entire (*integer*) undivided; without any slit or opening—some *anomitæ* have an *entire* hinge, and a perforated beak.

Beaks (*nates* s. *umbones*) the peaked or prominent parts of the shell on each side of the hinge.

a.) Reflex (*reflexæ*) bent backwards; inclined towards the back or surface of the valves.—This direction, so contrary to that which usually takes place in the beaks of shells, we have observed in two or three species of *anomitæ*.—The *term* is opposed to

Incurvated (*incurvatæ*) bent towards each other; and

Recurvated (*recurvatæ*) bent towards the posterior margin. In the Linnean writings, however, the terms *recurvatæ* and *reflexæ* appear to be synonymous.

b.) Divaricate (*divaricatæ*) separate; standing at a distance from each other.

Approximate (*approximatæ*) approaching near to each other, but not touching.

Converging (*conniventes*) inclined to, and touching each other.

Incumbent (*incumbentes*) converging, and one lying over the other.

c.) Spiral (*spirales*) with each beak twisted like the spire or wreath of an univalve shell.

Erect (*erectæ*)——the beak of the valve is said to be *erect*, if it rise (the valve being placed with its concavity downwards) perpendicularly from the hinge.—This position takes place in several *anomitæ*.

Margin (*margo*) the extreme edge of the shell, at which the valves separate. The *margin* is divided into the *inferior* part, or the margin of the hinge (*margo inferior*. *Linn.*) the *posterior* part, or the margin following the *anal* depression (*margo posterior*. *Linn.*) the *anterior* part, or the margin

---

next to the ligament (*margo anterior. Linn.*) and the *upper* part or margin opposite to the hinge (*margo superior. Linn.*)

Entire (*integer*) without indentations of any kind.

Sinuate (*sinuatus*) with a bending or indentation in the *upper* part of the margin—as in many species of *anomitæ.* The term is also applied to the valves (*valvæ sinuatæ*) when the *sinus* or bending of the margin is continued by a *channel* or *groove* (*canalis*) up one valve, with a corresponding convex wave or *ridge* (*lira*) down the other.

THE SINUS (*sinus*) differs according to the *margin* and the *ridge* and *channel.*

* *Margin.*

a.) Large (*magnus*) when it occupies not less than one half of the upper margin.

Small (*parvus*) when it does not extend through more than one third of the upper margin.

Long (*longus*) when the depth of the *sinus* at the margin exceeds its breadth.

Obsolete (*obsoletus*) scarcely distinguishable at the margin.

b.) Angular (*angulatus*) forming an angle at the margin.

Rounded (*rotundatus*) forming a curve without any angle or break; not angular.

Cuneiform (*cuneiformis*) long, and ending in an acute angle.

Obtuse (*obtusus*) rounded; but forming only a small segment of a circle.

Truncate (*truncatus*) ending in a straight line at the margin—so that the *sinus* has somewhat of a square appearance—or seems as if it had been cut off, where it would otherwise have formed a curve.

c.) Plaited (*plicatus*) with large, angular indentations at the margin.

Waved (*undatus*) with large, obtuse or rounded indentations *b.*) 76. Cortical (*corticale*) having its origin from the *outer bark.*

---

at the margin. The indentations in the margin of the sinus are to be numbered by the *points*, which are directed towards the beak of the *smaller* valve. They vary from two to nine: when they exceed that number, the sinus is properly said to be *dentate, crenate,* &c. The *plaits* or *waves* of the margin are not always continued by the same kind of folds down the *ridge* and *channel*—those of an *angular* form frequently passing into obtuse or rounded furrows, while the *waved* are often continued by sharp-ridged folds. In many instances, also, the indentations at the margin of the sinus are very large and strong, without any correspondent folds on the surface of the valves.

Dentate (*dentatus*) with small indentations in the margin.

** *Ridge and channel.*

a.) Continued (*continuatus*) when the bending at the margin is continued down the valves by the *ridge* and *channel*, which gradually diminish till they reach the beaks.

Half-continued (*semi-continuatus*) continued by the *channel* down the larger valve; but without the correspondent *ridge* in the other valve.

Abbreviated (*abbreviatus*) not continued down to the beaks—growing obsolete at a small distance from the margin.

b.) Striated (*striatus*) with the *ridge* and *channel* longitudinally marked with slender lines.

Sulcated (*sulcatus*) with the *ridge* and *channel* longitudinally marked with deep and broad lines.

Smooth (*lævis*) neither *striated* nor *sulcated.*—The *ridge* and *channel* of the *sinus* are often *smooth*, when the lateral parts of the valves are marked or scored with lines.

c.) 77. Lignal (*lignale*) having its origin from the *wood*.
&c., &c.

VALVES (*valvæ*) the pieces of which the bivalve is composed.

a.) Oval (*ovales*) oblong, the extremities rounded and equal.

Ovate (*ovatæ*) oblong, the extremities rounded, but not equal. —In shells the *extremities* of the *oval* or *ovate* figure may be formed either by the *beak* and opposite *margin*, or by the lateral *margins*; according as the extent of the valves from the hinge to the superior margin is greater or less, than the extent of the valves in a transverse direction.—Hence

b.) Longitudinally (*longitudinaliter*)

Transversly (*transversim*) or

Obliquely (*oblique*) must be added to the terms oval, ovate, oblong, &c. when, for the sake of specific differences, it becomes necessary to distinguish the direction in which the valves have been produced or extended—as, longitudinally oval (*longitudinaliter ovales*) oval, the diameter of the valves from the hinge to the opposite margin exceeding the transverse, or the diameter of the valves from side to side: transversly oval (*transversim ovales*) oval in a contrary direction; the sides of the shell being equally produced and forming the two extremities of the oval figure:—obliquely oval (*oblique ovales*) oval, but with one side of the shell more produced than the other, so that the valves, though regularly oval, are inequilateral (*valvæ inæquilateræ*) &c., &c.

c.) Obovate (*obovatæ*) are longitudinally ovate; but narrower at the base or hinge than at the opposite extremity.

Scrotiform (*scrotiformes*) are obovata; gradually swelling from a small or contracted beak and hinge, till the shell becomes gibbous at the superior margin or extremity.

UNIVALVE (*univalvis*) consisting of a single piece or shell.

VOLUTIONS OR WREATHS (*Anfractus*) the circumvolutions of a spiral or twisted shell.

2. External parts; as

a.) 78. Radical (*radicale*) having its form from the *root*.

---

a.)Involute (*involuti*) revolving within, and, in a great measure, hidden by the first or outward wreath.—We believe, this is not exactly the sense, in which the term is used by Linné.

Manifest (*manifesti*) more or less external; visible.

b.)Disjunct (*disjuncti*) disjoined; more or less distant from each other.

Contiguous (*contigui*) close; not separate.

c.)Extrinsic (*extrinseci*) contiguous, but not inserted or indented one into another.

Inserted (*inserti*) each wreath received or indented, more or less, into that which surrounds it.

Slightly inserted (*subinserti*) almost extrinsic.

AMBIT (*Ambitus*) in depressed univalves, the circumference or back of the outward wreath.

DISK (*Discus*) In depressed univalves, the surface on each side of the shell, exclusive of the ambit.—The *amenitæ* give examples in the use of the foregoing terms, *a*, *b*, *c*, &c.

† FULCIMENTS. Vide pages 88 and 97.

The terms employed by *Linné* and other naturalists, in determining the various species belonging to this tribe of animal bodies, are numerous; but we are not acquainted with any work, in which a regular or scientific explanation of them has been given.—The following Tabular View of the *parts*, &c. of the *Fulciment* (drawn up some years back to assist our investigation of the fossil subjects) may not, therefore, be unacceptable to the student. We must premise, however, that it is offered as a mere sketch, which we should be happy to see improved and filled up, by the more experienced in this part of Natural History.

The reader will observe, that we have not always adhered to the terminology used by Gmelin in his descriptions of these *zoophyta*. As, however, the edition of the *Systema*, which bears his name, is *b.*) 79. Truncal (*truncale*) deriving its form from the *trunk* or stem. A *truncal reliquium* may be

---

the one usually referred to, we undoubtedly should have done so, if we had found him uniform in the application of his technical language: but this is by no means the case; the same *part*, or its modifications, being frequently designated by terms completely dissimilar; particularly in those species which have been taken up from Pallas and Solander.

Fulciment. (*Fulcimentum.*)

TABULA SYNOPTICA PARTIUM.

- FULCIMENTUM
  - VESICULA, *Bullula*
    - Osculum
    - Basis
  - DISSEPIMENTUM
    - Superficies sup.
    - Superficies inf.
  - STIRPS, *Tubus*, *Stipes*, *Cumulus*
    - Margo
    - Cellula
      - Paries
      - Axis
      - Fundus
      - Receptaculum, *Denticulus*, *Calyculus*, *Porus*, *Stella*, *Anfractus*
        - Operculum
        - Margo
        - Osculum
        - Centrum, *Septum*
      - Lamella
        - Basis
        - Margo
    - Ambulacrum
    - Interstitium
    - Rachis
    - Geniculum
    - Articulus
    - Ramus, *Lacinia*
      - Ramulus, *Lacinula*
  - BASIS

80. Cauline (*caulinum*) or originating from the *stalk* of an herb.

DEFINITIONS.

PRIMARY TERMS.

The FULCIMENT is distinguished according to its *consistence* and *parts*.

* CONSISTENCE.

CORAL (*corrallium*) a fulciment of a firm and, often, stony substance; as in *Madrepora*, *Millepora*, *Cellepora*, *Isis*, many of the *Gorgoniæ*, &c., &c.

CORALLINE (*corallina*) a fulciment of a membranous, filamentous, crustaceous, or, often, friable substance; as in the genus *Corallina*; also in *Sertularia*, *Flustra*, &c., &c.

SPONGE (*spongiæ*) a fulciment of a reticulated, fibrous, and, generally, flexible substance; as in the genus *Spongia*. The masses of interwoven fibres called *sponges* are merely *fulciments* to a living gelatinous matter with which they are cloathed in the recent state.

* * PARTS.

BASIS (*basis*) the part by which the fulciment is attached to another body.

STIRP (*stirps*) the whole of the fulciment rising from the basis, exclusive of the *dissepiments* and *vesicles*.

A. *Kind.*

a.) Tube (*tubus*) the stirp peculiar to the *Tubipora* and *Tubularia*.——When jointed, as in many *Tubulariæ*, it is denominated a

Culm (*culmus*) from its resemblance to the stalk or stem of the *grass* tribe.

Stipe (*stipes*) is a stirp rising above the basis in a simple, stemlike form, and expanding into, or sending out, branches of another structure from or near the top only; as in *Corallina Peniculum*, Ell. Zooph. Tab. 7. fig. 5, 6. Corallina Phœnix. Ell. Z. T. 25. f. 2. &c.

Mass (*cumulus*) the stirp of a *common* fulciment when it does not affect a plant or shrub-like form.

81. Culmal (*culmale*) having the form of a *culm*, or the stem of the *grass* tribe.

The term is also used for an *aggregate* fulciment, when the stirplets are considered collectively.

b.) Stirplet (*stirpula*) each distinct or separable stirp, rising from the common base of an aggregate fulciment.

Tubule (*tubulus*) a simple tubular stirplet.

Culmule (*culmulus*) a jointed, tubular stirplet. Vide *Tube* and *Culm.*

B. *Parts of the stirp.*

c.) Branch (*ramus*) is the subdivision of a stirp.

Branchlet (*ramulus*) the subdivision of a branch.——————In a foliaceous or leaf-like stirp, the primary divisions are better expressed by the term *Laciniæ*, or segments; and the secondary, or subdivisions of the laciniæ, by *Lacinulæ* or little segments.

Rachis (*rachis*) that part of the stirp from which lateral branches are put out; as in *Sertularia frutescens*, Ell. Z. T. 6. f. a. *Sertularia Pennatula*, Ell. Z. T. 7. f. 1. 2. &c. &c.

Axil (*axilla*) the angle which a branch forms with the stirp.

d.) Joint (*articulus*) that part of an articulated stirp which lies between two *knots*; as in *Isis Hippuris*, T. 3. f. 1. 5. Ellis.

Knot (*geniculum*) the juncture of the joints—the part by which one joint is united to another; as in *Isis Hippuris*—*Tubularia indivisa.* Ellis.—When the knot is formed by an intermediate body, distinct in substance or structure from the joints which it connects, it is properly called the

Internode (*internodium*) as in *Isis Hippuris*—*Isis coccinea*, T. 12. f. 5. Ellis.—These distinctions between the *joint*, *knot*, and *internode*, are not, however, those which are always observed by authors in other parts of natural history.—Vide *Martyn's Language of Botany*, art. *Articulus, Nodus, Geniculum*, &c.

82. Scapal (*scapale*) having the form of a *scape,* or a stem bearing the fructification and not the leaves—Perhaps, never found fossil.

---

e.) Surface (*superficies*) in *foliaceous* and *subfoliaceous stirps* (v. inf.) is distinguished as

upper (*superf.* s. *pagina superior*) or the *surface* in which the *apertures* are placed; as in *Madrepora cinerascens,* T. 43. *Flustra bombycina,* T. 4. f. b. Ellis.—and

under (*superf.* s. *pagina inferior*) or the *surface* destitute of *apertures*; as in *Madrepora ampliata,* T. 41.—*cucullata,* T. 42. Ellis——When both sides of a *foliaceous stirp* have cells, the above distinction, of course, cannot take place—as in *Madrepora interstincta,* T. 56. &c. Ellis.

Margin (*margo*) the edge of a *foliaceous* or *subfoliaceous stirp,*—the line which separates the *upper* from the *under surface;* as in *Madrepora cucullata,* T. 42. Ellis. &c.

Ambulacra (*ambulacra*) the elevated and, more or less, flexuous parts of the surface, which wind between the *apertures* in the *Madreporæ conglomeratæ* et *concatenatæ;* as in *Madrepora phrygina,* Ell. Z. T. 48. f. 2. *Madr. meandrites,* T. 48. f. 1. &c., &c.

Interstice (*interstitium*)	
——— of the surface.	In *common* fulciments, the space between the margins of the apertures when not elevated into *ambulacra.*
f.) ——— of the interior parts of the *mass.* }	——————— the space between the *walls* of the cells.

Cells (*cellulæ*) the holes or cavities of the stirp, in which the zoophytes reside.

a. *The parts of the Cell.*

a.) Walls or Partitions (*parietes*) the parts which immediately form or define the lateral limits of the cells.—————— In

83. Petiolar (*petiolare*) having the form of a *petiole*, or a partial stem connecting the leaf with the main stem or its branches.

---

proper cellular fulciments, and in those which are *aggregate*, when the apertures are terminal, the *paries* is external, and constitutes the surface of the stirp; as in *Madrepora Patella*, Ell. Z. T. 28. f. 1—4. *Madrepora flexuosa*, Ell. Z. T. 31. f. 5. *Tubipora musica*, Ell. Z. T. 27. &c. In *cumulate* fulciments, and in those which are *arbuscular* with *lateral* cells, the *parietes* are mostly *internal*, and perfectly distinct from the parts which form the surface; as in *Madrepora Ananas*, Ell. Z. T. 47. f. 6. *Madrepora radiata*, Ell. Z. T. 47. f. 8. &c. &c.

b.) Lamellas (*lamellæ*) are thin, plate-like parts with which the cavities in *Madreporæ* are divided. The principal of these are perpendicular, radiating from the axis of the cell to its circumference.—The *base* of a perpendicular *lamella* is the part which lies next the *axis*—its *margin* is the edge or extremity, visible at the aperture of the cell.

Axis (*axis*) the middle part of the cell, extending from the aperture, or external opening, to the bottom; and round which the *perpendicular lamellas* in *Madreporæ* are placed.

c.) Bottom (*fundus*) the extremity of the cell, opposite to the external opening.

d.) Receptacle (*receptaculum*) the upper extremity of the cell, into the concavity of which the body of the zoophyte is received or withdrawn. ———————————In *Sertularia*, and in some species of *Madreporæ*, the *receptacle* is distinct in form and structure from the more internal parts of the cell; in *Milleporæ*, *Tubiporæ*, &c. it differs little from the bottom (*fundus*) or the intermediate part, in which the *stipe* (*stipes*. v. former note, p. 96) of the animal is generally fixed.

84. **Stipital** (*stipitale*) having the form of a *stipe*, or a stem passing into leaves, as in the *Palms* and *Ferns*.

---

1. *The different kinds of receptacles are*

1. Denticles (*denticuli*) small, pointed, and generally tooth-shaped *receptacles*, placed, mostly, on the sides of the *stirp*, at each joint, in *Sertularia*.

   Calycles (*calyculi*) little cup-shaped, external receptacles, found also in *Sertularia*.

2. Pores (*pori*) the receptacles peculiar to the *genera Millepora* and *Corallina*. In *Corallina* the *pores* are the external extremities of capillary tubes, constituting the interior part of the *stirp*. In *Millepora*, also, the pores open into tubular cells, which are frequently disposed in a longitudinal direction.

3. Stars (*stellæ*) the lamelloso-stellated receptacles in *Madrepora*. When the opening of the star has an elongated form, and is more or less flexuous, it is distinguished by the term *Anfractus*; as in *Madrepora labyrinthica*, Ell. Z. T. 46. f. 34. *Madrepora gyrosa*, Ell. Z. T. 51. f. 1. &c., &c.

2. *The Parts of the receptacle are the*

Aperture or mouth (*osculum*) the external opening of the receptacle.

Lid (*operculum*) a moveable part covering the aperture in some species. *Millepora truncata*, T. 23. f. 8. Ellis.

Margin (*margo*) the part which defines the aperture or mouth. A *distinct* margin is formed by the top or edge of the *wall* (*paries*).

Center (*centrum*) the middle part of the aperture. In *Madrepora* this is generally formed by the apex or summit of the *axis*. It sometimes takes an oblong form, when the stars are elongated, dividing the aperture down the middle, like a partition; it is then distinguished as the

85. Caudical (*caudicale*) having the form of a *caudex* or the *trunk* of a *tree*.—The *caudex*

Septum (*septum*)—Ellis and Solander have called this the *dissepiment*; a term used by later authors to express a very different and distinct part in cellular corals. Vide *dissepiments*.

Dissepiments (*Dissepimenta*) transverse plate-like parts by which the perpendicular stirplets, in *Tubipora musica*, *Madrepora musicalis*, &c. are united.

Vesicles (*Vesiculæ*) little bladder-like bodies externally attached to various parts of the stirp in the genus *Sertularia*. They have always a regular, determinate shape, distinct from that of the *denticles*.—When they take an hemispherical form, they are denominated *bullulæ*; as in the *Cellariæ* of *Ellis*.

The mouth (*osculum*) of the *vesicle* is its aperture—

The base (*basis*) the part by which it is affixed to the stirp.

In some species, the *vesicles* appear to be ovaries, and contain eggs only.—It may be doubtful, therefore, whether they ought to be considered as a part of the *fulciment*.—In many instances, however, they seem to be such—merely covering *hydræ* of a larger size than those in the *denticles*; and from which proceed clusters of eggs, or young ones perfectly formed and living—Vide Ellis's "English Corallines."

The *vesicles*, as well as the *denticles* and *calycles*, from their minuteness, can rarely be objects of investigation in the fossil state.

SECONDARY TERMS.

The FULCIMENT (*Fulcimentum*)

a.) Proper, or simple (*proprium* s. *simplex*) formed by, and supporting only, a single zoophyte. *Madrepora Cyathus*, Ellis. T. 28. f. 7.

Common, or compound (*commune* s. *compositum*) formed by, and supporting several distinct individuals of the same species of zoophyte. *Madrepora favosa*, Ellis. T. 50. f. 1. &c. &c.

is a *part* of the *root,* according to the Linnean principles of Botany; (v. Phil. Bot. p. 38.

---

b.)Solitary (*solitarium*) having only a single stirp, rising from the base. *Antipathes spiralis,* Ellis. T. 19. f. 1. *Millepora truncata,* T. 23. f. 1.

Aggregate (*aggregatum*) composed of several stirplets, rising from a common base. *Madrepora cespitosa,* Ellis. T.31. f. 5.

c.)Cellular (*cellulare*) formed with cells. *Madreporæ,* &c.

Cell-less (*ecellulosum*) without cells. *Gorgoniæ,* &c.

d.)External (*externum*) enclosing the animal or animals by which it was formed. All *cellular* fulciments are *external.*

Internal (*internum*) covered by the animals by which it was formed. All *cell-less* fulciments are *internal*—cloathed with living, animal matter, full of small vessels and pores, which contain (in some genera) polype-like zoophytes. *Gorgonia, Isis, Spongia,* &c.

e.)Arbuscular (*arbusculare*) like a little tree, or plant; elongated; neither cumulate nor foliaceous.

Shrubby (*fruticosum*) arbuscular, branching from the base, without any common or main stem. *Madrepora hirtella,* Ellis. T. 37.

Caulescent (*caulescens*) arbuscular, branching from a common stem—the main stem and its subdivisions or branches similar in structure. *Gorgonia Viminalis,* Ellis. T.12.f.1.

Stipitate (*stipitatum*) arbuscular, with a *stipe* or main stem differing in structure from the subdivisions or branches. *Corallina Peniculum,* Ellis. T. 25. f. 1.

Foliaceous (*foliaceum*) very thin and expanded like a leaf. *Flustræ,* &c.

Plano-foliaceous (*plano-foliaceum*) spreading horizontally over the body to which it is fixed. *Flustra.*

Frondescent (*frondescens*) foliaceous, and dividing into branches or segments. *Flustra bombycina,* Ellis. T.4. f. b.

Caudex ascendens)—but it appeared scarcely necessary to preserve this distinction in the present instance.

&c. &c.

Cumulate (*cumulatum*) formed into a heap or mass; neither arbuscular nor foliaceous. *Madrepora conglomerata. Madr. abdita*, Ellis. T.50. f.2.

f.)Membranous (*membranaceum*) of a tender and pliable consistence. *Flustræ*, &c.

Coriaceous (*coriaceum*) leather-like, tough and pliable.
Cork-like(*suberosum*)soft and elastic like cork. } *Gorgoniæ*, &c.
Ligneous(*lignosum*)of the consistence of wood.
Osseous (*osseum*)———————— of bone.
&c., &c.

Crustaceous (*crustaceum*) brittle, and which may be broken by the fingers. *Corallinæ.*

Stony (*lapideum*) brittle, but not easily broken. *Madreporæ*,&c.

g.)Fibrous (*fibrosum*) consisting of parallel fibres or threads.

Spongy (*spongiosum*) consisting of reticulated and interwoven fibres. *Spongiæ.* Some of the *stony fulciments* may be also called spongy, when their texture is very open or porous. *Madrepora muricata*, Ellis. T.57.

h.)Conglomerate (*conglomeratum*) with conglomerated receptacles. vide Receptacle.

Concatenate (*concatenatum*) with concatenated receptacles. v. Receptacle.

Alveolate (*alveolatum*) with close, angular cells, like those of an honey-comb. *Madrepora retepora*, Ellis T. 54. f. 3, 4, 5.

i.) Adnate (*adnatum*) spreading over, and adherent to some other body, without the intervention of a distinct or root-like base. The term is usually applied to *foliaceous fulciments*, when

d.)86. **Foliar** (*foliare*) belonging to a *leaf*.—This
is sometimes

---

they expand horizontally, and are attached to the substance, on which they have been formed, by the whole of their under surface. *Flustræ*, &c.

Parasitical (*parasiticum*) adhering to another fulciment. The *adnate* fulciments, are often parasitical.

The Basis (*Basis*)

a.) Simple (*simplex*) not differing in form or substance from the *stirp*. *Madrepora interstincta*, Ellis. T. 66. f. 1. *Madr. rotulosa*, Ellis. T. 55. f. 1.

Rooting (*radicans*) affixed by radicle-like tubes or fibres. *Sertularia Pennatula*, Ellis. T. 7. f. 1. *Corallina Peniculum.* T. 7. f. 5.

Spread (*explanata*) horizontally extended round the bottom of the stirp. *Gorgonia Briareus*, Ellis. T. 14. f. 1.

Creeping (*repens*) running along shells, fuci, &c. in the form of fibres, and generally putting out several distinct stirplets. *Cellaria* (*Sertularia*. Gmel.) *tulipifera*, Ellis. T. 5. f. a.

b.) Proper or peculiar (*propria*) supporting a single *stirp*. *Gorgonia Umbraculum*, Ellis. T. 10. f. 1.

Common (*communis*) supporting several *stirplets*. *Sertularia Pinaster*, Ellis. T. 6. f. b. *Sertularia Pennatula*, Ellis. T. 7. f. 1.

&c. &c.

The Stirp (*Stirps*)

a.) Simple, or undivided (*simplex* s. *indivisa*) without branches. *Antipathes spiralis*, T. 19. f. 1. *Madrepora fungites*, T. 28. f. 5, 6. Ellis.

Branched (*ramosa*) furnished with branches.

Dichotomous (*dichotoma*) branched, and with the branches dividing regularly into pairs. *Corallina marginata*, T. 22. f. 6.—*cylindrica*, T. 22. f. 4. Ellis.

87. Frondal(*frondale*) deriving its form from a *frond*, or the peculiar leafing of *Ferns* and

---

Trichotomous (*trichotoma*) branched; dividing by threes. *Corallina tridens*, Ellis. T. 20. f. a.

Pinnate (*pinnata*) branched; the branches lateral, regularly placed in two single, opposite rows. *Sertularia frutescens*, Ellis. T. 6. f. a. A.

Nettedly-branched(*reticulato-ramosa* s.*retiformis*) branched; the branches uniting with one another, so as to form a kind of expanded reticulation or net-work. *Gorgonia Flabellum*, T. 17. ?. *Millepora reticulata*, T. 26. f. 5. ? Ellis.

Flatly-branched (*in plano ramosa*) dividing in one direction only, so as to exhibit a flat, or fan-like expansion of branches. *Gorgonia pretiosa*, T. 13. f. 3. 4.—*flammea*, T. 11. Ellis.

b.)Jointed (*articulata*) as in *Isis*, *Corallina*, &c.

Nodous (*nodosa*) swelling or protuberant at the junctures of the joints; as in *Isis ochracea*. Gmel. p. 3793. n. 3.

Continuous (*continua*) without joints.

b.)Cauliform (*cauliformis*) long, slender, and more or less flexuose, like the stem or stalk of a plant—with or without branches. *Antipathes spiralis*, T. 19. f. 1. *Gorgonia viminalis*, T. 12. f. 1. *Isis Hippuris*, T. 3. f. 1. Ellis.

Scapiform (*scapiformis*) erect, straight, without branches; like the shaft of a column; which may be *cylindrical*, *prismatic*, &c. &c. *Madrepora musicalis*. *Tubipora musica*. We are not acquaintd with any recent species, except the above, to refer to, as an example of this term; but the form is common in the fossil subjects, particularly in aggregate fulciments.

Turbinate (*turbinata*) inversly conical—small at the base, and increasing upwards. *Madrepora Cyathus*, Ellis. T. 23. f. 7.

Palms.—*Frons,* in the *Phil. Bot.* is considered as a species of *trunk* or *stem*—elsewhere

---

d.)Deform (*deformis*) without any regular or determinate shape; as in many of the *spongiæ.*

Multiform (*multiformis*) running into many different shapes.

Nodular (*nodularis*) in form of a nodule or rounded protuberance—this may be globular (*globosa*) fungiform (*fungiformis*) oval (*ovalis*) reniform (*reniformis*) &c. &c.—as in *Madrepora phrygia,* T. 48. f. 2.—*denticulata,* T. 49. f. 1.—*galaxea,* T. 47. f. 7. Ellis.

e.)Spread (*explanata*) more or less flat or expanded; as in *Madrepora interstincta,* T. 56. Ellis.

Subfoliaceous (*subfoliacea*) spread, and with somewhat of the form of a leaf. *Madrepora cucullata,* T. 42.—*ampliata,* T. 41. f. 1. 2. Ellis.——The *subfoliaceous* stirp differs from the *foliaceous,* in being less thin and flexible—or not so nearly resembling a true leaf.—See *Fulcimentum foliaceum,* p.110.

Marginate(*marginata*)having a distinct margin,dividing the *upper* from the *under* surface;as in *Madrepora cinerascens,*T.43.Ellis.

f.) Basaltiform (*basaltiformis*) composed of close, prismatic stirplets—as in *Eris. Madreporites floriformis,* Derby.Pet.p.44.

Botryoidal (*botryoides*) composed of somewhat globular, protuberant stirplets, so as to resemble a bunch of grapes.—*Spongia botryoides,* T. 58. f. 1. Ellis.

&c. &c.————The forgoing terms, *d, e, f.* are appropriate to the *stirp* of the *cumulated fulciment.* See *Cumulus,* p. 104—and *Fulcimentum cumulatum,* p. 110.

The *terms,* used in distinguishing the fulciment at large, are generally applicable to the *stirps* as a part.

The STIRPLETS (*Stirpulæ.*)

a.)Dispersed (*dispersæ*) scattered; not united in any way so as to form an aggregate body or *mass* of stirplets, though all rising from the same base. *Sertularia Pinaster,* T. 6. f. b. Ellis.

Consociate (*consociatæ*) collected into one body or *mass.* *Tubipora musica,* T. 27. Ellis.

Linnæus has defined it to be a *leaf* formed from a *stipe*.

---

b.)Remote (*remotæ*) distant from each other.

Approximate (*approximatæ*) near to each other, but not touching.

Contiguous (*contiguæ*) close; touching one another.

Coalescent (*coalescentes*) uniting or growing together in particular parts only. *Madrepora flexuosa*, T. 31. f. 5. 6. Ellis.

Coadunate (*coadunate*) joined together their whole length. *Erism. Madrepor. duplicatus*, T. 30. Derby. Petr.

&c. &c.

c.)Fasciculate (*fasciculatæ*) collected in bundles; many springing from the same point or basis. *Madrepora Anthophyllites*, T. 29.—*fascicularis*, T. 30. f. 1. Ellis.

Cespitose (*cespitosæ*) interwoven or matted together. *Madrepora Anthophyllites.—flexuosa*, T. 31. f. 5. Ellis.

&c. &c.

d.)Equal (*æquales*) of the same size. *Tubipora musica*. Ellis. T. 27.

Unequal (*inæquales*) not corresponding in size. *Erism.Madr. duplicatus*, Derby. Petr. T. 30.

e.) Parallel (*parallelæ*) placed in the same direction, and continuing at the same distance from each other. *Tubipora musica*, Ellis. T. 27.

Divergent (*divergentes*) tending various ways from one point or common basis. *Madrepora fascicularis*, T. 30. Ellis.

&c. &c.

The BRANCHES of the Stirp (*Rami*)

a.)Distinct (*sejuncti*) not adhering to each other.

Conjunct (*conjuncti*) cohering throughout their whole length; as in *Corallina Phœnix*, T. 25. f. 2. 3. Ellis.

Anastomosing (*anastomosantes*) running much one into another, but not uniting their whole length—as in *Millepora reticulata*, T. 26. f. 2.—*Gorgonia Flabellum*, T. 17. Ellis.

e.) 88. Fulcral (*fulcrale*) belonging to a *fulcre*— this may be

---

Coalescent (*coalescentes*) cohering with one another in distant parts only; as in *Madrepora flexuosa,* T. 31. f. 5. Ellis.

b.)Alternate (*alterni*) coming out regularly, one after another, from different sides of the main stirp; as in *Sertularia Filicula*, T. 6. f. C. c. Ellis.———Alternate branches may be

Pinnatedly-alternate (*pinnatè-alterni*) arranged *alternately* on the two opposite sides of the main stirp; as in the species just referred to—or

Circularly-alternate (*circulatim-alterni*) arranged in a spiral manner about the stirp—rising by steps round the stirp—— This disposition of the branches, a common one in plants, is, perhaps, rare in the present bodies; we have a specimen of fossil *millepore coral,* however, in which it takes place.

Opposite (*oppositi*) placed over against each other——opposite branches may be

Pinnatedly-opposite (*pinnatè-oppositi*) arranged on two sides of the stirp; each branch being opposite to another——or

Decussatedly-opposite (*decussatim-oppositi*) arranged, crosswise, in four rows; each pair of opposite branches being at right angles with the pairs next above and below it.

c.)Scattered (*sparsi*) neither opposite nor alternate—without any regular order.——Crowded (*conferti*)—Verticillate (*verticillati*)—Fascicled (*fasciculati*) &c. &c. &c.——All the terms employed in Botany to distinguish the *situation, direction*, and *structure*, of the branches of a plant, are applicable to the branches of an *arbuscular fulciment.*

The Rachis of the Stirp (*Rachis*)

Even(*lævis*)with an even surface—Striated (*striata*) marked with slender lines.—Wrinkled (*rugosa*)—Nodous (*nodosa*) &c. &c. &c.

89. Stipular (*stipulare*) bearing the form of a *stipule*.

The JOINTS of the Stirp (*Articuli*)

a)Cylindrical (*cylindrici*) round, or without angles; longer than they are thick, and with the extremities and middle part of each joint nearly equal; as in *Corallina cylindrica*, T.22.f.4. Ellis.

Filiform (*filiformis*) very long and slender;—thread-like; as in *Corallina Penicillus*, T. 25. f. 4. Ellis.

Turbinate (*turbinati*) inversely conical—each joint attenuated at the base and broad at the top; as in some of the joints of *Corallina granifera*, T. 21. f. C. c. Ellis.

Moniliform (*moniliformes*) round and short, with convex ambits—resembling beads in a necklace; as in *Corallina Rosarium*, T. 21. f. h. Ellis.

Compressed (*compressi*) laterally flattened; as in *Corallina Tuna*, T. 20. f. e. Ellis.—Compressed joints may be round (*rotundi*)—Kidney-shaped(*reniformis*)—Wedge-shaped (*cuneiformes*)—&c. &c.

d.)Striated (*striati*) marked with superficial parallel lines.

Sulcated (*sulcati*) marked logitudinally with deep channels; as in *Isis*.

&c. &c.

e.)Denticulate (*denticulati*) furnished with small tooth-shaped *receptacles*; as in the genus *Sertularia*.

Calyculate (*calyculati*)——with cup-shaped *receptacles*. *Sertularia*.

f.)Conform (*conformes*) resembling each other in shape.—Difform (*difformes*) of different shapes in the same stirp.—Equal (*æquales*) of the same size.—Unequal (*inæquales*) not corresponding in size.

&c. &c.

The KNOT and INTERNODE (*Geniculum et Internodium.*)

a.)Simple (*Geniculum simplex*) uniting the joints merely by their extremities,without the *internode*; as in *Corallina cylindrica*, T. 22.f.4. Ellis.

f.) 91. **Fructual** (*fructuale*) **belonging to the** *fruit* ——This may be

---

The INTERSTICES of the Stirp (*Interstitia*)

* On the *surface.*

Flat (*plana*)—Concave (*concava*)—Sulcated (*sulcata*)—Rough (scabra)—Radiated (*radiata*)—Even (*lævia*)—&c., &c.

* * In the *interior part* of the *mass.*

a.)Filled (*expleta*) made up between the cells—the space between the stirplets not empty.

Solid (*solida*) filled with a close, uniform substance—

Cavernous (*cavernosa*) full of large, angular holes or cavities. *Madrepora radiata*, T. 47. f. 8. Ellis.

Porous (*porosa*) full of small, circular holes. *Madrepora interstincta*, T. 56. Ellis.

Partitioned (*dissepta*) divided by dissepiments or partions. *Tubipora musica*, T. 27. Ellis.

Empty (*inania*) void; not filled up between the cells. *Madrepora angulosa*, T. 34. Ellis. *Tubipora Strues.* Gmel. Syst. Nat. p. 3755. n. 10.

The CELLS (*Cellulæ*)

a.) Simple (*simplices*) not divided by *lamellæ.* *Tubipora*, *Millepora*, &c.

Lamelloso-stellate (*lamelloso-stellatæ*) divided by perpendicular lamellæ, disposed in a star-like form. *Madrepora.*

Lamelloso-reticulate (*lamelloso-reticulatæ*) divided both by perpendicular and horizontal lamellæ. *Madrepora.*

b.)Poriform (*poriformes*) like simple pores.—*Corallina*, &c.

Tubæform (*tubæformes*) like tubes. *Tubularia*, &c.

Urceolate (*urceolatæ*) pitcher-shaped; more or less bellying out towards the base, and contracted at the mouth or aperture. *Cellepora.*

Alveolate (*alveolatæ*) crowded and angular, like the cells in a honey-comb. *Madrepora retepora*, T. 54. f. 3. 4. 5. Ellis.

92. Seminal (*seminale*) having the form of a *seed*——or

Ringent (*ringentes*) with an oblong, or gaping aperture; the upper margin rounded or arched. *Flustra.*

c.)Equal (*æquales*)—Unequal (*inæquales*—Conform (*conformes*) Difform (*difformes*) &c. &c. &c.

The WALLS or PARTITIONS of the Cells (*Parietes*)

a.)Distinct or separate (*sejuncti*) divided from each other; not adhering to, or touching one another. *Tubipora musica*, T. 27. *Madrepora angulosa*, T. 34. Ellis.

United (*conjuncti*) cohering, but still separable from one another. *Erism. Madr. floriformes*, T. 44. f. 5. Derby. Petrif.

b.)Common (*communes*)—When the *cells* are separated from each other merely by a simple partition, continued through the whole mass. *Madrepora retepora*, T. 54. f. 3. Ellis.

Proper (*propria*)—When each *cell* is inclosed by its particular wall, distinct or separable from the other parts of the stirp. *Madrepora Carduus*, T. 35.—*fascicularis*, T. 30. f. 1. 2. Ellis.

&c. &c.

The AXIS of the Cell (*Axis*)

a.) Simple (*simplex*) when it takes no other form but that which arises from the concentration of the lamellæ. *Madrepora stellulata*, T. 53. f. 3. 4. Ellis.

Tubular(*tubulatus*)when the lamellæ are united before they reach the centre, which hence takes the form of a cylindric cavity—We are not acquainted with any recent *Madreporæ* to refer to, as an example of this structure; but we have met with it more than once in fossil species.

Cavernous (*cavernosus*) full of small holes or cells. *Madrepora favosa*, T. 50. f. 1. Ellis.

Void (*inanis*)—When the *lamellæ* neither unite with one another, so as to form a tube, nor reach the centre, which hence

93. Pericarpial (*pericarpiale*) having the form of a *pericarp* or *seed-vessel*—a *pericarpial reliquium* may be

remains open, as in the tubular axis, but without its defined cylindrical structure. *Madrepora cinerascens*, T. 43. f. 1. Ellis.

Solid (*solidus*) filled; neither tubular nor cavernous.

b.) Detached (*solutus*) distinct or separate from the *lamellæ*. v. terms under *centre of the receptacle.*

&c. &c.

The Bottom of the Cell (*Fundus*)

Simple (*simplex*) not differing in form from the other parts of the cell—Straight (*rectus*)—Oblique (*obliquus*) not in the same direction as the other part of the cell—Cylindrical (*cylindraceus*)—Conical (*conicus*) &c. &c. &c.

The Lamellæ of the Cell (*Lamellæ*)

a.) Perpendicular (*perpendiculares*) dividing the cell longitudinally, or from the aperture to the bottom.

Transverse (*transversæ*) dividing the cell horizontally, or from side to side.

Radiating (*radiantes*) running from the centre, or axis of the cell, to the wall or circumference, in a star-like form. The principal *Lamellæ* are *perpendicular* and *radiating*. *Madrepora.*

Circular (*circulares*) perpendicular and disposed round the axis in concentric circles.—The *circular* and *transverse lamellæ* are wanting in many of the *Madreporæ.*

b.) Distinct (*sejunctæ*) when the *radiating lamellæ* are continued from the circumference of the cell towards its axis, without uniting or running one into another. *Madrepora Cyathus*, T. 28. f. 7. Ellis.—*Madr. stellulata*, T. 53. f. 3. 4. Ellis.

Coalescent (*coalescentes*) joining or uniting with one another before they reach the axis.

94. Capsular (*capsulare*) with the form of a *capsule*—

Anastomosing (*anastomosantes*) running much into one another. *Madrepora*—?, T. 51. f. 2. Ellis.

Free (*liberæ*) neither attached to the axis nor to each other. *Madrepora Fungites*, T. 28. f. 5. 6. Ellis.

c.) Simple, or undivided (*simplices s. indivisæ*) when the *radiating lamellæ* are not branched or subdivided. *Madrepora Fungites* T. 28. f. 5. 6. Ellis.

Dichotomous (*dichotomæ*) dividing by pairs

Trichotomous (*trichotomæ*) dividing by threes—*Madrepora Patella*, T. 28. f. 1—4. Ellis.

&c. &c.

d.) Equal (*æquales*) all of the same size—Unequal (*inæquales*) not corresponding in size. *Madrepora Fungites*, T. 28. f. 5. 6. Ellis.

e.) Continued (*continuæ*) running from the circumference to the axis. *Madrepora Pleiades*, T. 53. f. 7. 8. Ellis.

Abbreviated (*abbreviatæ*) shortened; not reaching the centre or axis; as some of the *lamellæ* in *Madrepora Fungites*, T. 28. f. 5. 6. Ellis.

&c. &c.

f.) Remote (*remotæ*) distant from each other—Approximate (*approximatæ*) near to each other. &c.

g.) Projecting (*exertæ*) standing out above the opening or margin of the cell. *Madrepora hirtella*, T. 37. *Madrepora Carduus*, T. 35. Ellis.

Suppressed (*suppressæ*) not protruded; sunk below the margin of the aperture.—*Madrepora Anthophillites*, T. 29.—*flexuosa* T. 31. f. 5. 6. Ellis.—*Stella concava*.

h.) Entire (*integræ*) not divided or indented in the margins. *Madrepora radiata*, T. 47. f. 8. Ellis.

Serrate (*serratæ*)—Denticulate (*denticulata*) &c. &c. with the

95. **Strobilar** (*strobilare*) with the form of a *strobile*—

---

margin *serrate*, &c. &c. *Madrepora Fungites*, T. 28. f. 5. 6. Ellis.——The above terms, from *b.* to *h.* respect only the *radiating lamellæ.*

The RECEPTACLE (*Receptaculum*)

a.) **Genuine** (*genuinum*) differing in its external form or structure from the other parts of the cell. *Sertularia.*

Spurious, or continuate (*spurium* s. *continuatum*) not distinguished by its external form from the other parts of the cell. *Madrepora, Tubipora,* &c.——The *genuine receptacle* has a peculiar structure, distinct from that of the tubular part of the cell to which it is affixed; as in *Cellaria* (*Sertularia, Linn.*) *tulipifera*, T. 5. f. a. A.—*Sertularia frutescens*, T. 6. f. a. A. A 1. Ellis. &c. &c.——The *spurious receptacle* is merely a continuation of the general concavity of the cell which it terminates; as in most of the *Madreporæ, Milleporæ*, &c. &c.

b.) **Prominent** (*prominens*) standing out beyond the general surface of the stirp. *Sertularia.*

Sessile (*sessile*) prominent, but immediately attached to the stirp; not peduncled. *Sertularia Pennatula*, T. 7. f. 2. Ellis.

Peduncled (*pedunculatum*) elevated on a peduncle, or stalk-like branch. *Sertularia verticillata*, p. 50. n. 21. Ellis.

Adpressed (*appressum*) prominent, but laterally applied, or pressed, as it were, close to the stirp. *Sertularia frutescens*, T. 6. f. a. Ellis.

Spreading (*patens*) prominent, and forming an acute angle with the stirp. *Sertularia cupressina*, p. 38. n. 5. Ellis.

Horizontal (*horizontale*) prominent, and at a right angle with the stirp. *Sertularia tulipifera*, T. 5. f. A. Ellis.

&c. &c.

Suppressed (*suppressum*) sunk; not prominent. *Flustra.*

96. Drupal (*drupale*) with the form of a *drupe*—
g.) 97. Floral (*florale*) deriving its form from the

---

c.)Lateral (*laterale*) placed on the sides of the stirp. *Sertularia.*
Unilateral (*receptacula unilateralia*) all the receptacles placed on one side of the stirp.
Bifarious (*bifaria*) placed only on the two opposite sides of the stirp.
Quadrifarious (*quadrifaria*) disposed on four sides of the stirp. v. *one-rowed*, &c.
Terminal (*terminale*) placed at the extremity of the stirp or its branch. *Sertularia volubilis*, T. 4. f. e. f. F.—*Madrepora Anthophyllites*, T. 29. Ellis.
Axillary (*axillare*) placed in the *axil*, or the angle which the branch forms with the stirp. *Madrepora axillaris*, T. 13. f. 5. Ellis.——The above terms, *c.* are only applicable to the *receptacles* of *arbuscular fulciments.*
d.)Unipaginal (*receptacula unipaginalia*) disposed only on one of the surfaces of a foliaceous or subfoliaceous stirp. *Flustra bombycina*, T. 4. f. b.—*Madrepora ampliata*, T. 41. f. 1. Ellis.
Bipaginal (*bipaginalia*) disposed on both surfaces of a foliaceous or subfoliaceous stirp. *Madrepora interstincta*, T. 56.—*Flustra papyracea*, p. 13. n. 4. Ellis. These terms, *d.* have not been used either by Linnæus, Pallas, Solander, or Gmelin (whose works we have chiefly consulted in forming the present *Table*); but, if admitted, will be found useful, in many instances, in preventing a circumlocution; such as, "——*stirpe poris utrinque instructa*"——" —*uno tantum strato cellulosa*"—&c.
Marginal (*marginalia*) placed in the margin of a foliaceous or expanded stirp. *Madrepora cinerascens*, T. 43. Ellis.
e.)Remote (*remota*) distant from each other.

flower.—*Floral reliquiæ* are very rare, if, indeed, they exist, in the mineral kingdom.—

Approximate (*approximata*) near to each other, but not touching at their margins.

Contiguous (*contigua*) touching at a part of their margins, but leaving interstices where the margins mutually recede from one another. *Madrepora annularis*, T. 53. f. 1. 2. Ellis.

Crowded (*conferta*) close; leaving no space between them; the cells being so formed as to indent, or fit into one another. *Flustra*.—*Madrepora retepora*, T. 54. f. 3.—*sideria*, T. 49. f. 2. Ellis.

f.) Distinct (*distincta*) not running into one another—each *receptacle* perfectly separated by its *wall* and *margin*, from those which surround it. *Flustra*.—*Madrepora porites*, T. 47. f. 1. 2. Ellis. *Distinct receptacles* may be *remote*, *crowded*, &c.

Conjunct (*conjuncta*) running into, or otherwise united with, one another—not distinctly separated by their margins. *Madrepora meandrites*, T. 48. f. 1.—*labyrinthica*, T. 46. f. 3. 4. Ellis.

Concatenate (*concatenata*) conjunct by means of their *lamellæ*, which pass over the margin of each aperture, and unite with those from the surrounding cells. *Madrepora cristata*, T. 31. f. 3. 4.——*labyrinthica*, T. 46. f. 3. 4. Ellis.

Conglomerate (*conglomerata*) conjunct by means of the *apertures*, which run into one another, so as to form more or less elongated and, generally, flexuose *receptacles* (*anfractus*) winding over the surface of the stirp. *Madrepora gyrosa*, T. 51. f. 1.—*phrygia*, T. 48. f. 2. Ellis.—The *receptacle* may be both *concatenate* and *conglomerate*; as in *Madrepora labyrinthica*, T. 46. f. 3. 4.—*cucullata*, T. 42. Ellis.

most of the delineations of supposed petrified flowers, given by early authors, are evidently

---

Connate (*connata*) laterally united, so as to appear but as one body. *Sertularia tulipifera*, T. 5. f. A. Ellis——Connate receptacles are *ternate*, *quinate*, &c. according to the number united.

g.) Ordinate (*ordinata*) disposed in rows, or in some other regular, determinable order.

One-rowed (*secunda*) forming one row only.—In these the receptacles are either placed in a single line; as in *Sertularia frutescens*, T. 6. f. a. A. Ellis—or, if in a double line, are so disposed, by being all *directed or turned towards the same side*, that they appear as one row only; as in *Cellaria* (*Sertularia, Linn.*) *neritina*, p. 22. n. 2. Ellis. In this latter sense, Solander has used the term *unilateralis*—— "cellulis unilateralibus alternis"—which he translates—"with alternate cells, *looking one way*." v. Ellis. Zooph. p. 21. *Cellaria*. n. 1. 2. 3.&c. In the *Syst.nat.* however, we find the essential characters of the same species to be stated with the term *secundus*—*unilateralis*—" cellulis s. denticulis unilateralibus"—may be retained to point out the *place* or situation of the cells or the receptacles, without any reference to their disposition or direction. v. *unilateralis*, &c.

Two-rowed (*disticha*) disposed in two opposite rows. *Sertularia Pinaster*, T. 6. f. b. B.—*Thuja*, p.41. n. .9 Ellis.

Four-rowed (*tetrasticha*) disposed in four rows. &c. &c.

Verticillate (*verticillata*) disposed in *whirls* or rings one above another. *Flustra? verticillata*, T. 4. f. a. A. Ellis.—This and the three preceeding terms respect the receptacles of *arbuscular fulciments* only.

Linear-ranked (*seriata*) disposed in numerous, extended, parallel lines or rows. *Madrepora seriata*, T. 31. f. 1. 2.—*undata*, T. 40. Ellis.

nothing more than representations of imperfect *reliquia* of other bodies, as shells, leaves,

---

Quincuncial (*quincuncialia*) placed in a quincunx order—i. e. so disposed that each receptacle forms the centre to the four next surrounding it. *Millepora truncata*, T.23. f. 2. Ellis.

Ternary (*terna*) placed three together.

Quaternary (*quaterna*) four together.

&c. &c.

Imbricate (*imbricata*) so disposed as to lie over each other, like tiles on a roof.

Inordinate (*inordinata*) not disposed in any regular or determinable order. *Madrepora muricata*, T. 57. Ellis.

Scattered (*sparsa*) inordinate, and at unequal distances from one another. *Millepora alcicornis*, p. 141. n. 19. Ellis.

h.) Calyciform (*raceptaculum calyciforme* s. *calyculus*) cup-shaped; wide and open at the mouth.

Calathiform (*calathiforme*) hemispherically cup-shaped, the margin of the aperture not spread or recurved. *Sertularia Pennatula*, T. 7. f. 2. Ellis.

Campanulate (*campanulatum*) bell-shaped; more or less bellying out at the base, with the margin of the aperture spreading and somewhat recurved.

Cyathiform (*cyathiforme*) obconically cup-shaped; like a wine-glass, wide at the mouth and gradually lessening to the base. *Flustra verticillata.*

Poculiform (*poculiforme*) cylindrically cup-shaped, with the base hemispherical, and but slightly, or not at all, spreading or recurved at the mouth. *Sertularia frutescens*, T.6. f. A. Ellis.—The *open mouthed* or *cup-shaped* receptacles (*calyculi* in *sertularia*) are generally described as *campanulate* (*denticuli campanulati*) though they differ in their form as much as the *small-mouthed* or pointed receptacles,

&c.—The tender substance of flowers in general appears to preclude the possibility of

---

to which the term *denticuli* ought, perhaps, to be appropriated. We conceive, therefore, that the terms *calathiform*, *cyathiform*, &c. as above defined, will be found particularly useful in distinguishing the *calyculated sertulariæ*. It is, perhaps unnecessary to add, we have selected the terms in question, from some proposed, by Mr. Salisbury, to be used in Botany. v. Linn. Trans. V. 5. p. 135.

Dentiform (*dentiforme* s. *denticulus*) tooth-shaped; small or pointed at the apex; not wide or large-mouthed. *Sertularia Pinaster*, T. 6. B.—*filicula*, T. 5. C. Ellis.

Conical (*conicum*) having the form of a cone; broad and round at the base, but gradually lessening to a point at the aperture.

Ovate (*ovatum*) egg-shaped, the apex being the smaller extremity.

Oval (*ovale*) egg-shaped, but with both extremities equal.

Inflated (*inflatum*) puffed out, or nearly globular towards the base, but suddenly becoming small and pointed at the aperture. *Sertularia filicula*, T. 6. f. c. Ellis.

Tubular (*tubulatum*) having the general form of a tube. *Sertularia halecina*, T. 10. Ellis's Engl. Corall.

&c. &c.——The above terms, from *h*. are applicable to the *genuine* or *distinct receptacle*.—The *structure* of the *spurious receptacle* is only to be distinguished by those terms which properly relate to the *form* of the aperture or mouth. v. *Osculum*.

The APERTURE of the receptacle (*Osculum*)

a.)Orbicular (*orbiculatum*) circumscribed by a round or circular margin. *Madrepora radiata*, T. 47. f. 8. Ellis.

Oval (*ovale*) circumscribed by an oval margin; the extremities their form ever being preserved in the fossil state.

---

of the oblong figure, forming the outline of the mouth, rounded and equal.

Quinquangular (*quinquangulare*) five-cornered; surrounded by a margin with five prominent angles.

Hexagonal (*hexagonum*)—————with six prominent angles. *Madrepora retepora,* T. 54. f. 3. Ellis.

&c. &c.

Ringent (*ringens*) oblong with the upper margin rounded, and the opposite extremity angular. *Flustra.*

b.)Elongated (*elongatum*) the longitudinal diameter greatly exceeding the transverse. *Madrepora phrygia,* T. 48. f. 2. Ellis.

Short (*breve*)-when applied to an oblong or oval aperture, imports the longitudinal diameter not greatly to exceed the transverse. *Madrepora sinuosa,* n. 35. Ellis.

c.)Straight (*rectum*)—Flexuose (*flexuosum*) &c. &c. v. *Ambulacra recta,* &c. &c.

d.)Very large (*maximum*)—Large (*magnum*)—Middle sized (*medium*)—Small (*parvum*)—Minute (*minutum*). There is no part of the fulciment that can properly be used in a reference to the *comparative* size of the aperture;—agreeable to the usual mode of measuring the parts of bodies in natural history.— Hence, the terms just stated apply only to positive magnitudes; as, *very large,* when not less than an inch in diameter—(note, when the diameter of the aperture differs with the direction in which it is measured, the smallest extent must be taken)—*Large,* not an inch, nor less than half an inch, in diameter—*Middle sized,* not half an inch, nor less than a quarter of an inch, in diameter—*Small,* not a quarter of an inch, nor less than a line, or the twelfth of an inch, in diameter—*Minute,* not a line, nor less than one fourth of a

The reader will note, that in the foregoing list of terms (*a.* 65.—*g.* 97.) we have marked

---

line, in diameter—*Very minute*, less than one fourth of a line in diameter.

e.) Open (*apertum*) not furnished with an *operculum* or lid.
Operculate (*operculatum*) having an *operculum*. *Millepora truncata*, T. 23. f. 1—8. Ellis.

f.) Wide (*patulum*) its diameter exceeding that of the lower part of the cell. *Madrepora Cyathus*, T. 28. f. 7. Ellis.
Spreading (*patens*) wide, with the margin expanded. *Madrepora Patella*, T. 23. f. 1—3. Ellis.
Contracted (*coarctatum*) less than the general concavity of the cell. *Sertularia quadridentata*, T. 5. f. g. Ellis.

g.) Marginate (*marginatum*) with a regularly defined margin. *Sertularia Pennatula*, T. 7. f. 1. 2. Ellis.
Immarginate (*immarginatum*) without any regular or definable margin. *Madrepora galexea*, T. 47. f. 7. Ellis.

h.) Radiated (*radiatum*) divided by radiating *lamellæ*. v. Lamellæ. *Madrepora*.
Reticulated (*reticulatum*) having both the radiating and circular *lamellæ* visible. *Madrepora cespitosa*, n. 67. Gmel. Linn. Syst. Nat.
Helmeted (*galeatum*) surmounted by a concave or helmet-like process. *Cellaria* (*Sertularia*. Linn.) *avicularia*, p. 22. n. 3. Ellis.
Tubulous (*tubulosum*) projecting from the cell in a tubular form. *Flustra tubulosa*, p. 17. n. 11. Ellis.
&c. &c.

i.) Terminal (*terminale*) at the end or top of the receptacle.
Lateral (*laterale*) on one side of the receptacle. *Sertularia anguina*, n. 42. Linn. Gmel. Syst. Nat. The aperture or mouth is usually terminal; but, in some few instances, is placed as in the species referred to.

those by capital letters, that have reference to the parts of plants or animals from which

---

k.)Distinct (*oscula distincta*) separated, not running into each other.

Confluent (*confluentia*) running into one another. *Madrepora dædalea*, T. 46. f. 1. 2. Ellis.

Labyrinth-form (*labyrinthiformia*) running much into one another, and scarcely exhibiting any separate or distinct terminations. *Madrepora labyrinthica*, T. 46. f. 3. 4. Ellis.

&c. &c.

The MARGIN of the Receptacle (*Margo*)

a.)Defined (*definitus*) determinate; its limits and form distinctly marked.

Obsolete (*obsoletus*) indistinct; not determinate; its limits not defined. *Madrepora galaxea*, T. 47. f. 7. Ellis.

b.)Proper, or distinct (*proprius*) surrounding and defining the limits of the aperture to one cell only. *Madrepora radiata*, T. 47. f. 8. Ellis.

Common (*communis*) uniting with the adjacent margins so as to form a part of the limits of several apertures. *Madrepora retepora*, T. 54. f. 3.—*Flustra carbasea*, T. 3. f. 6. 7. Ellis.

Double (*duplex*) common, but exhibting the junctions of the margins in a double line.

c.) Acute (*acutus*)—Obtuse (*obtusus*)—Dentated (*dentatus*)—Arched (*fornicatus*) &c. &c.

The CENTRE of the Receptacle (*Centrum*)

a.)Simple (*simplex*)—Hollow (*cavum*)—&c. &c. v. Secondary terms under *Axis*.

Corroded (*exesum*) full of superficial holes, as if worn or eaten.

Lobulate (*lobulatum*) sending off small, lateral divisions or segments, of the same form and structure as the main line of the *septum*. *Madrepora phrygia*, T. 48. f. 2.—*Mæandrites*, T. 48. f. 1. Ellis.

permanent species are formed; as Ossal, Testal, Foliar, &c.—the terms in small letter

---

Lacerated (*lacerum*) ragged; sending off small, lateral segments of different forms. *Madrepora dædalea,* T. 46. f. 1. Ellis.—This and the foregoing term apply only to the *oblong, solid* centre or *Septum.* V. Centre; primary terms.

Proliferous (*proliferum*) putting forth the rudiment of another stirp.

Lamellous (*lamellosum*) having a thin, plate-like, structure. *Madreporà dædalia,* T. 46. f. 1. 2.—*mæandrites,* T. 48. f. 1. Ellis.

&c. &c.

b.)Orbicular (*orbiculare*)—Oblong (*oblongum*)—Elongated (*elongatum*) &c. v. *Centrum,* p. 180.

c.)Large (*magnum*) occupying not less than one half of the diameter of the aperture.

Middle sized (*medium*) not half nor less than one third of the diameter of the aperture.

Small (*parvum*) not one third, nor less than one fourth, of the diameter of the aperture.

&c. &c.—These terms, *b. c.* apply only to the centre in *suppressed receptacles.* v. p. 124.

d.)Broad (*latum*)—Narrow (*angustum*)—Linear (*lineare*) &c.

e.)Equal (*æquale*) of the same breadth and form throughout its length. Unequal (*inæquale*) not equal or regular in its form or breadth. The term under *d. e.* apply to the oblong centre only.

f.) Flat (*planum*)—Concave (*concavum*)—Convex (*convexum*).

g.)Suppressed (*suppressum*) not so prominent as the lamellæ.

Prominent (*prominens*) equally elevated with the lamellæ, but not protruded.

Protruded (*exertum*) standing out above the margin of the aperture.

&c. &c.

relate to parts which afford only *temporary*

The Lid of the Receptacle (*Operculum*)

Flat (*planum*)—Convex (*convexum*)—Concave (*concavum*)—&c. &c.

The Dissepiments (*Dissepimenta*)

a.)Horizontal (*horizontalia*) at right angles, with the stirplets which they connect. *Tubipora musica*, T. 27. Ellis.

Oblique (*obliqua*) neither horizontal nor perpendicular—placed in a diagonal direction, with respect to the connected stirplets. —We have observed this position in the *dissepiments* of some fossil *Madreporæ*.

b.)Parallel (*parallela*) continuing in one direction.

Promiscuous (*promiscua*) crossing each other in various directions—

c.)Straight (*recta*)—Curved (*curva*)—&c.

d.)Distant (*distantia*) remote from each other—Approximate (*approximata*) near to each other—Crouded (*conferta*) close to each other; touching.

e.) Smooth (*lævia*)—Sulcated (*sulcata*)—Striated (*striata*)—Radiated (*radiata*).

&c. &c.

The Vesicles (*Vesiculæ*),

The secondary terms, applicable to the *vesiculæ*, are nearly the same as those by which the *disposition*, *situation*, and *form* of the *genuine receptacles* are distinguished, v. terms *b. c. g. h.* p. 124. 127. 128. &c.

Note, in the above table, the species enumerated for the purpose of pointing out the application of precedent terms, have generally been selected from the *Natural History of Zoophytes*, by Ellis and Solander. We preferred a reference to that work, rather than to any other we were acquainted with, as it contains most excellent figures, and may easily be procured by the English student.—The references are, for the most part, marked merely "*Ellis*."

species †. v. § V.

Matter or Substance. (*Substantia.*)

The *substance* of an extraneous fossil respects the material of which it is composed;—and is either *organic* or *mineral*.

A. 98. THE ORGANIC SUBSTANCE (*substantia organica)* of a *reliquium,* is the matter which existed in the original body, and which still retains the organic arrangement of its particles—

This may be either *earthy* or *inflammable* † †.

a. 99. THE EARTHY ORGANIC SUBST. (*substantia organ. terrea*) which principally occurs in *reliquia,* is *calcareous*—generally a *carbonate of lime;* sometimes a *phosphate.*

Obs. *Conservata of shells, corals, bones,* &c. afford examples of *calcareous organic substances*: v. p. 40. 47. &c.

---

† For an explanation of the botanical terms, from which we have formed those employed to distinguish the relation between the vegetal fossil and its original (v. *cuticular, truncal, cauline,* &c. &c.), the learned reader, unacquainted with the science of plants, may consult the *Philosophia Botanica* of Linné, or *Termini Botanici,* given in the sixth Vol. of *Amœnitates Academicæ*; to others we recommend the *Elements of Botany,* by Dr. Hull.

† † *Saline* and *metallic* particles may also exist *in* the organic matter of an extraneous fossil, but cannot be said properly to constitute the organic *substance,* as they do not retain the texture of the original.

b. 100. THE INFLAMMABLE ORGANIC SUBST. (*substantia organ. inflammabilis*) which occurs in extraneous fossils is, for the most part, either *carbonaceous* or *bituminous*.

Obs. Conservata of vegetable bodies; as of *leaves; wood*, &c. afford the principal examples of *inflammable organic substances*. v. p. 44. 47. Note, p. 50, &c.

B. 101. THE MINERAL SUBSTANCE (*substantia mineralis*) of an extraneous fossil, is the matter which has taken place of that which existed in the original body; or, if it once existed as a constituent part in the original, is the matter which has lost the organic arrangement of its particles. v. p. 51-66.

The *mineral substance* of a *reliquium* is either *earthy, inflammable*, or *metallic*; rarely *saline*.

a. 102. THE EARTHY MINERAL SUBST. (*substantia miner. terrea*) is, for the most part, *calcareous, argillaceous*, or *siliceous*; sometimes *barytic* or *magnesian*†.

Obs. The *simple earths*, variously mixed and combined with saline, inflammable, or metallic matter, constitute *earths* and *stones* in their natural state, or as they occur in the mineral kingdom.—These compounds, in a systematical arrangement, are generally ranked under that division, to which the most essential of the ingredients gives the characteristic property.

---

† The substances in which the *strontian, jargonic*, and some other earths, newly discovered, occur, have not, as yet, been found as constituents of extraneous fossils.

The earths and stones hitherto found under an extraneous form are as follows.

Calcareous Order.

* Carbonates.

Chalk. Kirw. p. 77.—Form, Animal—generally *Echinitæ*, more rarely shells or coral.

Limestone.

Compact.

Common. Kirw. p. 38.—F. Animal—rarely Veg.

Roestone. James. p. 480.—F. An. sometimes Veg. The smaller grained roestones, as those found in Rutlandshire (at Ketton) Essex, Northamptonshire, &c. frequently contain, and also constitute, the substance of petrifactions.

Swinestone. Kirw. p. 89.—F. An.—Frequently *Belemnitæ*.

Foliated.

Calcareous spar. Kirw. p. 86.—F. An. and Veg. This and the preceding stones form the substance of most animal petrifactions, particularly those belonging to the *vermis* class.

Tuffstone. Calc Tuff. James. p. 531. Tophus crustans, Gmel. Syst. Nat. T. III. p. 88. This stone frequently forms the matrix, but rarely the substance, of extraneous fossils—It sometimes, however, assumes the place and figure of the *moss*, *reeds*, &c. which, in the first instance, it had merely incrusted.

Marl.

Indurated. Kirw. p. 95. F. An. and Veg. abounds in vegetal remains, of which it frequently forms the substance.

Earthy. Kirw. p. 94. F. An. and Veg. Often forms the *nuclei* in testaceous remains.

Marlite.

Argillaceous. Kirw. p. 99. F. An.

Bituminous. Kirw. p. 103. Bituminous Marl Slate. Jam. p. 529. F. An. and Veg. The animal, generally of fish.

Calcareous Sandstone. Kirw. p. 361. F. An. We have seen an aggregate stone of this kind in the form of shells.

Ferricalcite. Kirw. p. 110. F. An.

* * Fluates.

Fluor.

Sparry. Kirw. p. 127. F. An. Fluor spar sometimes occurs in Derbyshire in the form of *Entrochitæ*; we have also found it, but not often, constituting *testal* reliquia.

* * * Sulphates.

Gypsum.

Compact. Kirw. p. 118. It has been observed, rarely contains extraneous fossils, but it is to be doubted if it ever really constitutes their substance.

Selenite. James. p. 567. We have found it crystallized in the cavities of shells, which were imbedded in *shale,* over the limestone strata of Derbyshire.

BARYTIC ORDER.

The native earths and stones of this order are but few. The only one, which has as yet been noticed under an extraneous form, is a sulphate, namely,

Baroselenite.

Compact. Kirw. p. 138.—This, it has been asserted, frequently constitutes the stony matter of petrifactions.—In Derbyshire both the *compact, foliated,* and *stirated* varieties of Baroselenite, are common; but we have never, as yet, been fortunate enough to discover any of these substances in the state now under consideration.

ARGILLACEOUS ORDER.

* Earths and Clays.

Tripoli.

Rottenstone. Cariosus. Gmel. Nat. T. 3. p. 146. Tripoli. Kirw. p. 203. F. An. We possess specimens of this stone constituting both the matrix and substance of shells and other marine bodies.—They are from Bakewell, Derbyshire†.

Lithomarga.

Indurated. Kirw. p. 188. An earth, which apparently belonged to this species, we once observed in the form of fluviatile shells.

Clay.

Potters'. Kirw. p. 180.—Sometimes forms the *nuclei* in testal remains.

Indurated. Kirw. p. 181. F. Veg.—frequently the substance of vegetal petrifactions.

* * Schists.

Shale.

Common. Slate Clay. Kirw. p. 182. F. Veg. very common.

Bituminous. Kirw. p. 183.—F. Veg. sometimes An.

Slate.

Argillite. Kirw. p. 234. Clay Slate. Jam. p. 334. F. Veg. and An. Argillite, when not a primary formation, is the matrix, and sometimes the substance, of petrifactions.

---

† The Rottenstone of Derbyshire is evidently produced by the disintegration of our *black limestone* or *marble*, above which it is deposited—not over *coal*, as Gmelin, we know not from what authority, has asserted. In other countries, Tripoli originates, probably, from the decomposition of argillaceous stones, as the author just mentioned observes, that his *Argilla Tripolitana* (which he considers as a species distinct from the Derbyshire *rottenstone*) is frequently decorated with vegetal impressions.

Aluminous Slate. Kirw. v. 2. p. 19. F. An. particularly of Ammonitæ.

* * * Trappose Stones.

Hornblende.

Common. Jam. p. 357.—has been observed forming the *nuclei* to testal reliquia. v. Kirw. G. Ess. p. 252.

Trap.

Figurate, or Basalt. Kirw. p. 231. F. An.??

Wacke. Jam. p. 376. F. Veg. ??—according to Sanssure, Abbé Fortis, Bruckenman, Jameson, Dr. Richardson, &c. &c. both animal and vegetal remains have been detected in Basalt and Wacke.—But though it is admitted that these stones sometimes (rarely indeed) form the matrix, it is still a question, if they ever constitute the substance, of extraneous fossils.

* * * * Aggregate Stones.

Argillaceous Sandstone. Kirw. p. 363. F. An. and Veg.—mostly the latter.

Rubble stone. Kirw. p. 366.—shells. v. Lesk. Mus. Coll. G. n. 874.

* * * * * Mica.

Glimmer. Kirw. p. 210.—is frequently dispersed through the sandstones and clays forming vegetal petrifactions, but never constitutes their whole substance.

SILICEOUS ORDER.

* Homogeneous Stones.

Quartz.

Massive. Kirw. p. 242. F. An. and Veg. v. Berg. Med. Syst. Foss. p. 78.

Crystallized.—sometimes lines the cavities of petrified shells, &c. &c. but cannot be said properly to form their *substance.*

Arenaceous. F, An. and Veg.—Arenaceous quartz exists in sandstones †, and in this state frequently constitutes the matter of petrifaction.

Hornstone.

Splintery. Chert. Kirw. p. 308. F. An. ††

---

† Masses of granular and arenaceous quartz are found in the veins and cavities of our Derbyshire limestones, *particularly near beds of chert,* and in this state form the *nuclei* to petrified shells and other marine relics.

†† Bergman considers petrifactions of *chert* as rare.—This stone is frequently attendant on primary rocks, in which case it is of course destitute of organic remains; but when it occurs in mountains of a secondary formation, as in Derbyshire, it usually abounds in petrifactions. Some mineralogists, as *Dolomieu,* and, lately, *Babbington,* have asserted that *Chert, Petrosilex,* or *Hornstein* of the Germans, is found only in primitive mountains. *Dolomieu,* however, makes a distinction between *splintery quartz,* as he calls this stone when it is found in secondary limestone, and the petrosilex of primitive rocks. *Dr. Babbington* does not, apparently attend to this distinction; his assertion, therefore, that *petrosilex* or *chert* is found only in primitive mountains, must be founded on a mistake.

Woodstone. Jam. p. 661. F. Veg. that of wood only †.

Flint. Kirw. p. 301. F. Animal, frequently of *Echini.*

Calcedony.

Common. Kirw. p. 297. F. An. and Veg. The animal, that of shells, the vegetal, that of wood.

Opal.

Semi-opal. Kirw. p. 290. F. Veg. and An.—Semi-opal sometimes constitutes petrified wood, and, in this state, is called *ligniform,* or *wood opal.*—Bones of quadrupeds have been found penetrated with a variety of *semi opal.*

Pitchstone. Kirw. p. 292. F. Veg.—of wood.

Jasper. Kirw. p 309. F. An? ††.

---

† This stone is ranked by *Karsten, Kirwan,* &c. as a *species* distinct from any of the foregoing siliceous stones. *Werner* and *Jameson* consider it as a *subspecies* of Hornstone.—Other mineralogists have supposed it to be merely a modification of quartz or flint.—It certainly does not appear that the substance, which the Germans denominate Woodstone, has, as yet, been subjected to any particular analysis, in order to determine its specific difference from the stones just mentioned.—External characters will here scarcely suffice as a ground of distinction, as they evidently depend, in a great measure, on the substance of the original body—and, if such structure be admitted as a distinction in this instance, why not in others?

†† According to Bergman (Med. de Syst. Foss. p. 78.) shells sometimes occur filled with jasper.—In another treatise (Phys. Geo. p. 304.) he seems to doubt it, although he quotes his friend

* * Aggregate Stones.

Agate. James. p. 181. F. Veg.—of wood†.

Siliceous Sandstone. Kirw. p. 364. F. An. and Veg.

MAGNESIAN ORDER.

Bole. James. p. 399. F. An.—We have seen testaceous remains with nuclei of a substance that had all the characters of this earth—The earths and stones of the magnesian order are almost wholly confined to primary rocks: hence their rare occurrence under extraneous forms.

b. 103. THE INFLAMMABLE MINERAL SUBST. (*substantia miner: inflammabilis*) of an extraneous fossil is either *carbonaceous* or *bituminous*.

Obs. The minerals which belong to the class of fossils generally denominated *inflammable*, are not

---

Ferber's authority in opposition to his own opinion on the subject. Ferber, indeed, appears to have repeatedly examined shells petrified in jasper, during his travels through Italy (v. Eng. Trans. by Raspe. p. 14. 27. 84. &c.)—Mr. Kirwan, however, suspects that *real* jasper is not found as a secondary stone—consequently, that it has not occurred as the substance or matrix of petrifactions.

† A combination or aggregate of calcedony, jasper, hornstone, quartz, &c. when the mass is capable of receiving a polish, and is decorated with more than one colour, is called an *agate*.—This sometimes occurs in petrified wood: the original matter having been displaced by two, three, or more of the siliceous substances just enumerated—the fossil compound thus formed is generally denominated a *petrifaction agate*—the petrified wood described by Linné under the title of *Lythoxylon Achatinum* (Mus. Tessinianum. p. 102.) appears to have been a most splendid specimen of this kind.

so common, under an organic form, as the *earthy*—The following are, perhaps, all that have yet been discovered among the *substances* of *reliquia*.

BITUMINOUS ORDER.

Bitumen.

Asphaltum. Kirw. p. 46. Trans. Linn. Soc. v. 4. p. 132. F. An. and Veg.—We have frequently found it filling the cavities of petrified shells and coral, and sometimes, though rarely, constituting their entire substance—In these, however, the subjects have been very small.—Asphaltum now and then forms, also, the external parts of vegetal remains.

Elastic. Hatchett. Trans. Linn. V. 4. p. 146. It is said has been found at Castleton in the form of a shell—We have ourselves observed small portions of it sticking in the cavities of petrified shells, but never bearing their form.

Jet. Hatchett. Trans. Linn. Soc. V. 4. p. 134.—Is sometimes decorated with vegetal impression; and has been found, we are informed, as the *substance* of petrified wood.

Coal.

Cannel. James. p. 75. F. Veg. and An. We have lately received from Lancashire petrifactions of fluviatile shells imbedded in pure *cannel coal*—In some of these specimens, coal forms the whole of the constituent matter of the shell; in others, only a part; the rest of the petrifaction being made out, or filled, with a *brown calcareous spar*.

Common pit coal. Kirw. p. 52-57. F. Veg.—Common pit or slate coal frequently constitutes the substance of vegetal petrifactions †.

Mineral charcoal. James. p. 90. F. Veg.—This substance sometimes forms the matter of extraneous fossils, after its original woody texture has been obliterated. v. Note, p. 52 † †.

c. 104. THE METALLIC MINERAL SUBST. (*Substantia miner. metallica)* of an extraneous fossil is usually an *ore of iron;* more rarely of *copper, silver, gold, quicksilver, lead,* or *zink.*

Obs. Metals when found in the earth in a pure or *simple* state are called *native*—when their respective *metallic properties* are lost by a combination with other matter, they are said to be *mineralized,* and the compound is called an *ore*—Earths and stones, when they contain metallic substances (either *native* or *mineralized)* in a certain proportion are also called *ores,* and are ranked according to the metal embodied.

---

† A contrary assertion has been advanced by one of our most distinguished mineralogists.—But every practical coal-miner in this kingdom must repeatedly have observed pit-coal under an organic form—that is, not merely with impressions of vegetal forms, confined to the surface of the stratum, but with the mass or body of the coal actually constituting the substance of petrifactions.

†† Bovey coal is not enumerated under this section, as it retains the texture of the original wood.—We consider it as an *organic* substance constituting *reliquia,* not as *mineral.* v. p. 135. A. 96.

The following metallic substances are such as have been observed either inherent in, or constituting, the matter of extraneous fossils.

GOLD ORDER.

Native Gold—according to Bergmen, has been observed in spots on the surface of fossil shells —It can scarcely be considered as one of the constituents of *reliquia.*

SILVER ORDER.

Native Silver—is sometimes inherent in petrifactions, but never constitutes their entire substance.—The bodies called *Hessian corn-ears,* supposed by some authors to be petrifactions of the *Phaloris bulbosa* †, are sometimes covered with native silver.

---

† These fossils are chiefly found in the mines of Frankenberg in Hesse, and generally consist of pyritous copper ores. v. *Copper Order.*—It remains disputable whether they are, or are not, genuine reliquia.—Some authors consider them as undoubted petrifactions of the plant above named, or of other congenerous grasses; while many mineralogists affirm, they are mere aggregations of small metallic crystals. Mr. Parkinson, who appears to have examined some very interesting specimens of these bodies, is decidedly of opinion that they are vegetal remains; but that they do not belong to any plant at present known in the recent state. We have not ourselves had an opportunity of forming any decisive judgment on the subject, as the specimens we have seen have been by no means good or perfect ones. It will not, however, be

Black Silver-ore. James. p. 177.—has been found in the forms just noticed.

COPPER ORDER.

Grey Copper-ore. Kirw. p. 146.—F. Veg.?

White Copper-ore. Kirw. p. 152.—F. Veg.?

Vitreous Copper-ore.

Compact. Kirw. p. 144.—F. Veg. This and the two preceding ores are found in the vegetal form refered to under *native silver.*

Copper-Pyrites. Kirw. 140.—F. An. and Veg.—It is sometimes the matter of testal reliquia, and frequently constitutes the external parts in petrified fish.—Bergman notices *copper pyrites* in the form of Anomiæ—The specimens were from Norway, in a matrix of *magnetical iron-ore.*

Malachite. Kirw. p. 131. F. An. and Veg.

Mountain Green. Kirw. p. 134. F. An. & Veg. —Malachite, mountain green, and, perhaps, other varieties of what are usually termed *calciform copper-ores,* sometimes constitute the substance of metallized woods. The most beautiful specimens of this formation are from

---

improper to remark, in this place, that all metallic bodies with a seeming organic structure ought to be well studied, previously to their being ranked with extraneous fossils. For, the *vein* is much less frequently the seat of *petrifactions* than the *stratum* (v. p. 12. r.), and, of course, those ores which occur *only* in veins, are rarely the constituents of *reliquia.*

the copper mines of Siberia. Many of these, however, are rather *impregnations,* than complets mineral *substitutions* : in others, little or no part of the original wood remains, while its texture and form are preserved, with the most perfect exactness, in the substituted ore.

Iron Order.

Argillaceous Iron-ore.

Common—Common Clay Ironstone, James. p. 326. F. An. & Veg.—most commonly the latter—the animal forms it assumes are generally those of fluviatile shells.

Nodular—Reniform Iron-ore, James. p. 329. F. An. & Veg. mostly the latter.

Bog Iron-ore. James. p. 334. F. Veg. rarely An.—The lowland, or bog iron-ores, frequently exhibit specimens of petrified wood, particularly in certain parts of the Russian empire. v. Tooke's View of the Russ. Emp. V. 1.

Sparry Iron-ore., Kirw. p. 130. F. An.—We have had specimens of fresh-water shells in this substance—The matrix an *argillaceous iron-ore.*

Blue Martial Earth. Kirw. p. 185. This substance is common in peat soils ; but though frequently incrusting, rarely forms, the substance of the vegetal *reliquium*—We have sometimes, however, met with it assuming the form of small, fibrous roots, &c.

Iron-Pyrites.

Common. James. p. 253. F. An. & Veg.

Radiated. James. p. 257. F. An. & Veg.

Hepatic. James. p. 261. F. An. & Veg. Iron pyrites sometimes constitutes the entire substance of the petrifaction; but more frequently only covers its surface in form of a metallic wash or thin film. It often forms the *nuclei* of hollow petrifactions, particularly of shells—It is sometimes the constituent of petrified wood.

LEAD ORDER.

Galena. Kirw. p. 216. We have seen specimens of fossil wood thoroughly impregnated with this ore.

QUICKSILVER ORDER.

Cinnabar. James. p. 127.—Fossil shells have been found filled with native cinnabar—It sometimes also constitutes their substance; but specimens of this kind are extremely rare.

ZINK ORDER.

Calamine. James. p. 411.—F. An. We have had specimens of this substance both in the form of shells and coral; but in each instance the petrifaction was probably a secondary formation; the calamine having, in appearance, assumed the place of calcareous spar, previously moulded in the organic form.

Blende.

Brown. James. p. 403. F. An.? Bergman observes that he has seen Blende in the form of coral—probably this variety, as he remarks, in another place (Med. Syst. Fass. p. 80.) that he possesses a specimen of it adherent to a fossil millepore.

Black. James. p. 407. F. An. We have found this mineral, in Derbyshire, in the form of shells.

D. 103. THE SALINE MINERAL SUBST. (*substantia miner. salina*) of extraneous fossils is confined, perhaps, to *iron vitriol.*

Obs. *Salts* can scarcely be said to form the matter of extraneous fossils—They exist in several earths and stones which frequently appear under an organic form, as well as in certain metallic minerals; but, in these, the production, or at least the separation, of the saline matter in a visible state, is usually preceded by the decomposition of the original stone or ore, and, of course, the loss of the organic structure, with which it was previously impressed—We have observed, however, *iron vitriol* (James. p. 32.) filling the cavities, and retaining, *in part,* the form of shells—These were in a matrix of *iron pyrites.* Bergman remarks (Med. de Syst. Foss. Nat. p. 47.) that animal bodies are sometimes found preserved in vitriolic waters. But the impregnating matter, in these and other like *conservata,* is not to be considered as the *constituent substance* of the extraneous fossil.—Shells, corals, &c. have been found, it is said, *sometimes* in *common* or *rock salt*—We believe, in such instances, which are very rare, that the salt has merely formed the matrix, not the substance, of the extraneous body.

Terms,

distinguishing the reliquium, according to its *substance.*

a.) 106. Mineralized *(reliquium mineralisatum)* with the organic form more or less perfectly combined with mineral matter. All *petrified reliquia* are *mineralized:* among the *conservated,* only those which are *impregnated (imbuta)* can properly be said to be so, as the constituent matter of the *converted (conversa),* &c. though changed from its original state, is still an organic, and not a mineral substance. (v. p. 66.—note, p. 52, and p. 135.)

107. Earthy *(terrenum)* mineralized by an *earthy substance* (102) in a loose or unconsolidated state.

108. Stony *(lapideum)* mineralized by an *earthy substance* (102) in a firm or consolidated state.—An earthy or stony *reliquium* may be

109. Calcareous *(calcareum),*

110. Siliceous *(siliceum),* &c. &c. according to the nature of its mineral substance. (v. 102.)

111. Metallic (*metallicum*) mineralized by a *metallic substance* (105)—A metallic *reliquium* may be

112. Ferruginous (*ferrugineum*)

113. Cupreous (*cupreum*), &c. &c. according to the embodied metal.

114. Inflammable (*inflammabile*) mineralized by an *inflammable substance* (103) an inflammable *reliquium* may be

115. Bituminous (*bitumineum*)

116. Carbonaceous (*carbonaceum*), &c.

117. Saline (*salinum*) mineralized by a *saline substance* (104)—a saline *reliquium* may be

118. Vitriolic (*vitriolicum*)

119. Muriatic (*muriaticum*), &c. &c.

b. 120. Unmineralized (*immineralisatum*) not combined with mineral matter—the form and substance of the original remaining in a more or less perfect state.—An unmineralized reliquium may be *semi-recent* or *converted*, according to the mode in which the organic matter has been preserved. v. Privation, p. 40. Conversion, p. 46.—and *terms* 10. semi-recent. 11. converted. p. 46.—An animal unmineralized reliquium may be

121. Osseous (*osseum*) retaining the *substance* of the original *bone*.

122. Crustaceous (*crustaceum*)———

of the *crustaceous covering* of certain animals †.

123. Testaceous (*testaceum*) —— —— —— of the *shell* of a worm.

&c. &c. A vegetal unmineralized reliquium may be

124. Ligneous (*ligneum*) retaining the *substance* of the *wood* of a plant.

125. Foliaceous (*foliaceum*) —— —— —— —— of the *leaf* of a plant.

&c. &c.

The *state* of the *organic substance* may be expressed by a compound term; as

c. 126. Bituminoso-ligneous (*bituminoso-ligneum*) preserving the structure of the wood, but *bituminated*, or passing into the state of a *bitumen*.

127. Carbonaceo-ligneous (*carbonaceo-ligneum*) retaining the structure of the wood, in the state of *carbon* or *charcoal*. v. p. 48-50.

&c. &c. ††

---

† The *crust* or covering of the Echinus is frequently found fossil in an *unmineralized* state.

†† In description, it will be sometimes necessary to note the *state* in which the *mineral substance* exists, combined with the organic form; as, an

Impregnating mineral (*min. imbuens*) is one which fills the pores of a *conservatum*.

Inherent m. (*m. inhærens*) one existing in small portions in the cavities of another mineral which forms the principal bulk of the *petrifaction*.

Constituent m. (*m. constituens*) that which forms the principal part of the petrifaction, &c.

Soil. (Solum.)

The *soil* of a *reliquium* is the surrounding body of mineral *strata*, &c. in any local extent through which such *strata*, &c. are found to be connected by certain geological relations †.

Strata or masses of stone, following each other in an uninterrupted order or series, are, according to *geologists*, of one *formation* ††—these collectively constitute a *soil*—When such order or series of strata is discontinued, either by the breaking off, or sudden termination, of its beds, by a change in the arrangement of those that follow, or by an entire dissimilarity in their composition or products †††, another *soil*, or *formation* of strata, is said to commence.

The *soils* of extraneous fossils differ in 1. their

---

† By *geological relations*, we mean to express that connection between one stratum or mass of stone and another, which arises from the *period* and the *mode* of their formation, and which the science of geology points out and explains.

†† That is, they have been formed by the same *agent*, and under a succession of similar circumstances. (v. p. 27-38.)

††† Particularly in such as are *extraneous*—Thus, when one series of strata contains *animal* relics only, and is followed or covered by another series, in which *vegetal* remains alone are found,

relative age, 2. *structure*, 3. *general materials*, 4. *particular products*, and 5. *parts*.

a. Relative age.

According to which the *soil* is either *primary* or *secondary* †.

A. 128. A PRIMARY SOIL (*Solum primarium*) is distinguished by the composition of its rocks and stones being destitute of organic remains; and by its *dipping* towards, and at length *underlaying*, some tract or soil in which extraneous fossils occur as integrant parts of the strata (v. p. 20. note. n. 7. et p. 6. i.)

Obs. The formation of *primary soils*, according to the opinion of most geologists, must have preceded the existence of plants and animals, as they never exhibit organic remains in the interior substance or fabric of their rocks—The shells and other extraneous bodies, now and then discovered in their fissures and external clefts, being generally supposed to have been introduced by the deluge, or some

---

they must be considered as distinct *soils*, though no material diversity in the arrangement of their respective strata may appear to take place.

† It may be conceived, we ought not here to have omitted the important distinction, established by Werner, between what are usually termed *transition* and *stratified* rocks, both of which are included in our *secondary soils*. The simple division of mountains into *primary* and *secondary*, first marked out by Lehman, appeared, however, better to apply to the present study, than the Wernerian distribution.

other natural event subsequent to the formation of the rocks themselves. (v. Kirw. G. Ess. p 163.)—Hence, the *reliquia* of *primary soils* are to be considered as modern, when compared with the incorporated extraneous fossils of *secondary mountains*.

Among the stones constituting *primary soils*, *granite* and its varieties form the principal or fundamental rock; next to which *gneiss* and *micaceous schistus* usually appear, and frequently alternate with each other; and after these *sienite*, *siliceous*, *schistus*, *granular* limestones and *porphyries* seem most general—*Serpentine*, *potstone*, *quartz*, *hornblende*, *topaz rock*, *pitchstone*, *jasper*, *petrosilex*, *fluor*, *gypsum*, *sandstones*, *rubblestone*, and *trap*; are also found in *primary soils* †.

B. 129. A SECONDARY SOIL (*Solum secundarium*) is distinguished by its holding organic remains imbedded in the substance of its strata ††.

Secondary soils may be divided into, 1. *most*

---

† Jasper, petrosilex, quartz, hornblende, porphyry, argillaceous schistus, trap, pitchstone, sandstone, rubblestone, fluor, and gypsum, belong both to primary and secondary soils—Trap, pitchstone, sandstone, rubblestone, fluor, and gypsum, are, however, most common in the latter.

†† Some substances, as *traps*, *gypsum*, *breccias*, &c. never or very rarely contain extraneous fossils, even when secondary stones; but are distinguished from those of a primary formation by alternating with, or covering, strata in which organic remains are found.

ancient and *ancient*, 2. *less ancient*, 3. *modern*, and 4. *very modern soils.*

a. 130. THE MOST ANCIENT, AND ANCIENT, SEC. S. (*S. secund. vetustissima* et *vetusta*) contain the *reliquia* of marine animals *only*: chiefly of *shells, corals,* and other bodies of the *vermis* class, whose originals, in most instances, are not now known to exist †. They always immediately follow or repose on *primary* soils.

They are sometimes, but not always, stratified—The lowermost strata contain but *few* petrifactions † †—These form soils that may be considered as the *most ancient* (*vetustissima*) of the secondary class—The upper strata *abound* in organic remains, and though *ancient* (*vetusta*) are less so, than those of the same order in which fewer petrifactions occur.

---

† The originals of the *anomitæ, ammonitæ, entrochitæ,* &c. found in these soils, have not been discovered in the recent state.

† † One of the characteristic distinctions of *transition* rocks, according to the Wernerian theory, is their *containing but few petrifactions* and those always marine, and chiefly of the *vermis* class: but to what order are those strata to be referred, that have every character of *transition rocks* except their paucity of extraneous fossils? Such are the limestone strata of Derbyshire, which abound in petrifactions, and which few geologists would rank as transition rocks, though they evidently do not belong to what Werner calls the "*floetz formations.*" Hence, it appears more eligible, at least in the present study, to consider the comparative ages of soils to be marked, in the first instance, rather by the *nature*, than the *quantity* of their organic contents—and hence, we consider those rocks that have a *few* marine petrifactions, and those that *abound* in them (their other characters being similar) to form but divisions of the same order.

Obs. The soils of this order generally appear in mountains, but are, for the most part, less elevated than the *primary* tracts which they invest or follow —Their rocks are all marigenous†. They consist of *compact limestone*, some *sandstones*, *petrosilex* or *chert*, *toadstones*, *rubblestones*, *argillites* and *basalt?* —perhaps some *marlites* and *shales*—rarely *porphory* and *sienite?*

b. 131. THE LESS ANCIENT SEC. S. (*S. secund. vetula*) contain *vegetal* petrifactions alone, or mixed, more or less, with *marine animal* remains—sometimes *marine animal* remains *only*; but these soils are distinguished from the *ancient secondary* by the *bones of fish*††, or of *amphibious* animals, being blended with the *shells* and other *vermal* relics††† —They follow and repose on the *ancient secondary* soils††††.

---

† This, in respect to basalt and other stones of the same order, will be disputed by many geologists.

†† *Glossopetræ*, *Bufonitæ*, *Ichthyospondyli*, &c. of authors.

††† Frequently *Echinitæ*, which are not common in the *ancient* secondary soils.

†††† May they not sometimes *immediately* repose on, or flank, *primary* mountains, without the intervention of the *transition* or

They are always *stratified*†.—They abound in extraneous fossils.

Obs. The formation of these *soils* is evidently posterior to that of the *ancient* secondary, as they constitute, in most instances, the lower hills and plains, under which *strata* from the *ancient* secondary mountains are always observed to dip.

The rocks belonging to the soils of this order, are some *limestones,* particularly the *porous* kinds, *chalk, basalt, sandstones, puddingstone, black coal, marl, marlite, shales, argillaceous ironstone, gypsum,* and *rock-salt* ††. They may be divided into *marigenous, semimarigenous,* and *alluvial*†††.

The *marigenous* contain *marine reliquia* only—as the *bones,* &c. of *sea fish, shells, echini,* &c.—They consist, for the most part, of the open-grained

---

ancient secondary rocks?—In some few instances, at least, this appears to be the case, as *coal,* which in general belongs to the *less ancient* secondary *soils,* has been found immediately on granite. v. Kirw. G. Ess. p. 346.

† Hence, in the Wernerian school, the rocks of these soils are distinguished by the term *floetz* or *stratified.*

†† Some of these substances, particularly *marl, gypsum,* and *rock-salt,* are perhaps more common to soils of later formation.

††† They have also been distinguished as *original* and *derivative* rocks:—such are generally considered to be *original* as have not, *in appearance,* been formed from the disintegrated parts of other rocks—the *derivative* are those which *evidently* owe their origin to the decomposition of more ancient strata. Many rocks, however, seemingly *original,* may, in reality, be *derivative.*

or less consolidated *limestones, chalk, marls,* and *clays*—rarely, perhaps, some *sandstone* strata. These appear to have been formed by *depositions* from the sea, when its surface was considerably higher than at present; but lower than in the first ages of the globe. (v. p. 13-38.)

The *semimarigenous* exhibit *marine reliquia* accompanied with *vegetal remains,* either in the same stratum, or respectively in strata alternating with each other. (v. p. 29-32. and notes †† p. 29. † p. 31.) They are chiefly *marls, clays, sandstone,* and some *coal-strata.*

The *alluvial* † contain *vegetal reliquia* alone, or mixed with *fluviatile shells* and the remains of *fresh-water fish*—the strata, principally, *sandstone, clay, marls, marlite, shales, ironstone,* and *coal.* Such soils have every appearance of having been deposited from large expansions of *fresh* water, collected in the hollow or vale-like depressions of more ancient strata ††.

---

† We not only call those soils *alluvial* that owe their origin to sudden inundations of rivers, &c. but also those which have been deposited by deep and more permanent collections of *fresh* water (v. p. 32. b. 14.). The reader must be careful, therefore, not to suppose, we confound the *alluvial* among the *less ancient secondary soils,* with the *modern alluvial* of the two following sections; and which, in most geological works, are exclusively distinguished by the title in question.

†† This is particularly observable in *coal* soils. v. William's Mineral Kingdom. V. I. p. 105.

c. 132. THE MODERN SEC. S. (*S. secund. recentia*) contain few *petrifactions*, but abound, for the most part, in *conservata*—The *vegetal* are frequently the remains of *trees*, as their *wood, leaves*, &c.—the *animal* are often the *bones* of unknown *quadrupeds;* when *shells* and other *marine* remains, they are generally such as belong to the neighbouring seas. They mostly repose on the *less ancient* soils.

They are *stratified*, but seldom regularly.

Obs. The soils of this order rarely appear in hills, but generally form extended plains and low lands, skirted by tracts of more ancient, mountain strata.

The strata belonging to these soils are usually of *brown coal, clay, sand, gravel, marl, bituminous wood*, and its varieties; sometimes *gypsum, salt rock*, and *ironstone;* more rarely *chalk* and *sandstone*.

They are either *marigenous* or *alluvial*—

The *marigenous* exhibit *conservata* of *sea shells, bones of fish*, &c. the strata commonly sand, and marl—the *alluvial* hold vegetal *conservata*, commonly in argillaceous beds; or the *bones* of *mammalia*, which are deposited in all the substances just mentioned, and sometimes in gypsum.

Modern soils are principally distinguished from the *less ancient* by their holding occasionally the bones of quadrupeds embodied in their strata; and by the materials of these strata being, generally, in a looser or less consolidated state—they differ from the soils of the next order in not being accompanied by the agent of their formation.

d. 133. VERY MODERN SEC. S. (*S. secund. recentissima*) differ from all the preceding soils in the process of their formation being carried on at the present day. They seldom contain *petrifactions*[†], except of wood; and the *conservata* are less common in them, than in the *modern* soils. They are found incumbent on most of the other soils; but those which they frequently overlay are the *modern* and *less ancient.*

Very modern soils are wholly superficial, never being covered by strata of any other formation. They are sometimes *stratified*—but never regularly.

Obs. The substances which belong to soils of this order are frequently in a loose and unconsolidated state; among these are *sand, gravel, loam, clay,* &c.

[†] Never, perhaps, except in particular instances, where the accumulating matter of the soil has surrounded already formed petrifactions, detached by various operations of nature from their original beds.—Such, it is said, have been observed in the *lava* of volcanos; and are, now and then, found in the sand and gravel, deposited by existing rivers—the latter, however, are always rounded or *worn* like other *debris;* and hence, are readily distinguished from organic remains, that occur imbedded in the soil, in which their mineral change has been effected.

—sometimes, however, in a firm or stony form; under this head may be reckoned *lava, tuffstone,* and some *bog-iron ores.*

The soils themselves may be divided, according to the agent nature employs in their formation, into *marine, fluviatile,* and *volcanic* †.

The *marine* consist of *sand, gravel,* &c. deposited on the sea shores, and in some inland situations to which the sea has still *occasional* access.

The *fluviatile* are found in vales and lowlands, through which the rivers forming them, at this day take their course.—They consist, also, of *sand, gravel, clay,* &c.—and, in some particular instances, of calcareous earth, consolidated into a *tophus,* which frequently involves in its composition moss, bones, and other organic bodies. The *deltas* of low land at the mouths of large rivers, consisting of *sand, mud,* &c. sometimes mixed with the trunks of trees and other vegetal matter, are also to be considered as fluviatile formations.

---

† To these might be added, perhaps with propriety, the *vegetal,* or soils originating from a daily accumulation of decayed vegetal matter—such are *peat* and *turf* soils—and the *animal,* or soils produced by animals which are still employed on their fabrication.—Many of the islands in the South Seas exhibit soils of this description, formed by an accumulation of *coral* rocks. Vide Forster's Voyage, V. 2. p. 146.—Phil. Trans. V. 57. p. 294.

The *volcanic* † consist of *lava, pumice,* &c. the ejected matter of still existent volcanos.

b. Structure.

According to which the soil is either *continuous* or *stratified.*

A. 134. A CONTINUOUS SOIL (*Solum continuum*) consists of a mass of mineral matter not divided into beds or strata.

Obs. *Primary* soils frequently come under this division; as their rocks do not commonly exhibit parallel joints or other external marks of stratification ††.—The *most modern* of the *secondary* soils also, are sometimes *continuous* or *unstratified*. Soils of this description seldom contain organic remains.

---

† The reader will remark, that we have confined our notice of *volcanic* soils to those of *very modern* production. We by no means, however, subscribe to the opinion, which some mineralogists hold, that the vestiges of extinct volcanos are not discoverable among the *more ancient* strata. Indeed, there is reason to suppose, that volcanos have existed during every period of the earth's formation; and, that the consequences of their eruptions may be traced among the most early mineral productions, even such, perhaps, as are truly primeval—at the same time, we cannot attribute to their operations, those extensive effects, contended for by some modern geologists.

†† We conceive, however, that this arises, in some cases, from the immense thickness of a stratum;—which may be such as to conceal its connection with other beds from observation. Thus the large blocks or masses of *granite,* which often constitute *primary* soils, may be only the detached or shatter parts of an enormous stratum, whose extent prevents its real form, as well as its dependance on similar strata, from being traced.

B. 135. A STRATIFIED SOIL (*Solum stratarium*) is divided into beds or strata.

The soils of this division are either *regularly* or *irregularly* separated into beds.

Regularly (*regulariter*) when the strata preserve their parallelism and, consequently, their respective thicknesses, throughout the extent of the soil which they collectively form.

Irregularly (*irregulariter*) when the parallelism of the strata is not preserved.—This may arise from the diminished or increased thickness of the beds, in particular parts of the soil—and, sometimes, from the difference which takes place in the *dip* and *course*† of the strata.

Obs. Stratified soils consist either of one species of stone, separated into strata by seams (*semi-strata*) of clay or other matter; or, of beds of various substances alternating with one another††.

c. *Materials.*

According to which the soil is either *calcareous, argillaceous,* or *siliceous.*

A. 136. A CALCAREOUS SOIL (*Solum calcareum*) is one in which the chief mass of its earths and stones belong to the calcareous order. It may be further distinguished, as being

---

† Vide p. 170. note.

†† Mountains which consist of one kind of stone are called, by Kirwan, *unigenous*; those formed from strata of different substances, *polygenous*.

a. 137. Cretaceous (*S. cretaceum)* when *chalk* forms the principal material.

b. 138. Marmorean (*S. marmoreum)* in which *limestone* beds abound.

c. 139. Marlaceous (*S. calcareo-margaceum)* in which *calcareous marl* predominates.

&c. &c.

B. 140. AN ARGILLACEOUS SOIL (*Solum argillaceum)* abounds in beds of clay, or other substances belonging to the argillaceous order. An argillaceous soil may be said to be

a. 141. Schistose (*S. schistosum*) when *shale* or its varieties † form the beds.

b. 142. Arenaceo-argillaceous (*S. arenaceo-argillaceum*) when *argillaceous sandstones* constitute the principal strata.

&c. &c.

C. 143. A SILICEOUS SOIL (*Solum siliceum)* in which stones of the *siliceous* order are most abundant. A siliceous soil may be

a. 144. Quartzy (*S. quartzosum*) when *quartz* forms the principal rocks.

b. 145. Arenaceous (*S. arenaceum*) in which siliceous *sand* abounds.

c. 146. Sabulous (*S. sabulosum*) in which *gravel* abounds.

&c. &c.

---

† Slate clay, bituminous shale, alum slate, &c. &c.

d. Particular Products.

According to which the soil is said to be

A. 149. **CARBONIFEROUS** (*Solum carboniferum*) bearing or producing coal.

B. 148. **FERRIFEROUS** (*Solum ferriferum*) producing iron.

&c. &c.

c. Parts.

The *parts* of the soil, which have immediate relation to extraneous fossils, are the *tract, seat,* and *matrix*.

A. 149. **THE TRACT** (*Tractus*) is the superficial *part* of the *soil* forming in some determinate extent on the earth's surface.

A *tract* is distinguished according to the *soil* of which it is a part (v. p. 155.); and as being either *general* or *partial*.

a. 150. A **GENERAL TRACT** (*Tractus generalis*) is one which runs through a large extent of country, and is bounded by *several tracts* of a different nature.

b. 151. A **PARTIAL OR INCLUDED TRACT** (*Tractus inclusus*) is generally of small extent, and always inclosed or surrounded by *one tract* only, of a different kind.

Obs. Carboniferous soils often form *partial* tracts: the rock on which they have been deposited rising on all sides of the coal land, and constituting its boundary by a circular tract of one formation.

B. 152. THE SEAT (*Sedes*) is that *part* of the soil in which the *reliquium* and its *matrix*, if distinct, are lodged—when no distinct or separate *matrix* immediately surrounds the extraneous body, the seat is properly considered to be the matrix indefinitely extended (*matrix continuata*).

The *seat* is either *aqueous* or *mineral*.

a. 153. Aqueous seats (*Sedes aquariæ*) are lakes, running waters, &c. in which *reliquia* (frequently petrifactions of wood †) occasionally occur.

---

† It has been a subject of dispute, whether the siliceous petrifactions of wood found in water, have been generated there, or in the surrounding and subjacent strata—Some authors supposing, that extraneous bodies thus circumstanced may have been detached by the agency of torrents, floods, &c. from their original beds, and subsequently reposited in their present situation. When the contiguous mineral bodies are such, as are known to contain *petrified wood*—that is, when they consist of sand, gravel, clay, &c. forming alluvial beds, or masses lodged in the veins or fissures of more ancient strata—this may undoubtedly have been the case: but, as the petrifaction of the wood thus imbedded must have been effected by the percolation of water impregnated with siliceous matter, we see no reason to deny the possibility of the same effect being produced by the waters of lakes and rivers, when they contain (as some undoubtedly do) siliceous earth, either in a dissolved or suspended state. Indeed, the petrifying quality of several waters, in various parts of the world, seems now to be pretty generally acknowledged—that of the water of Lough Neagh, in Ireland, was particularly eminent at one time—and the water-courses of our mines in Derbyshire have, within our own knowledge, produced some very fine specimens of woodstone. Many of the lakes in

b. 154. Mineral seats (*Sedes minerales*) consist of mineral matter, and are distinguished according to their *structure* and *materials.*

* *In structure,*

The *mineral seat* is either a *mass, stratum,* or *rift.*

A Mass (*Massa*) is a body of earth, stone, &c. having no determinate or regular extension.

Obs. The *mass* is not the seat in which extraneous fossils are usually lodged, but they sometimes occur in it.

A Bed or Stratum † (*Stratum*) is a body of earth or stone, &c. in length and breadth indefinitely extended (mostly in an horizontal or inclining

---

Germany, Italy, &c. &c. are also noted for this formation. Mr. Kirwan, however, justly remarks, that " several lakes, or other waters, that anciently possessed a petrifying power, have since lost it, by having imparted the greater part of the stony particles they contained to such substances as were capable of retaining them." G. Ess. p. 14.

† Many geologists of the Wernerian school use the terms *beds* and *strata* with the following distinction.—*Beds,*—when the soil consists of different substances alternating with each other.—*Strata,*—when the soil, though divided into beds, is composed only of one species of stone, or other mineral substance. We do not, however, see the utility of this discrimination; and in one case, it evidently produces a confusion in the use of the term *stratified,* or necessarily limits its employment to descriptions of *unigenous* soils; since it would certainly be improper to call a mountain, or other extent of soil, *stratified,* in which no *strata,* according to the above distinctions, were present.

direction) but of a determinable, and, more or less, uniform thickness.

A stratum is said to be *regular* (*stratum regulare*) when it is parallel with the accompanying strata, and continues throughout uniform, or nearly so, in its thickness.

Irregular (*stratum irregulare*) when it takes a different direction in its *dip* † &c. from that of the attendant strata; or when it does not preserve the same thickness through any considerable extent.

A semistratum †† is a very thin seam or stratum of clay, &c. separating the thicker strata of stone, or other matter, from one another.

A Rift (*Rima*) is a cleft or separation in the *mass* or *stratum*; generally filled with mineral substances distinct from that which forms the body of earth or rock intersected—The *rift*, according to its structure, may be denominated a *fissure* or a *vein*.

---

† In miners' language, when a stratum is not perfectly horizontal, its fall or declination is called the *dip*; its elevation, the *rise*; and the edge of the stratum terminating the *rise*, is denominated the *crop* of the bed—when this appears at the surface, the stratum is said to *crop* (in Derbyshire *basset*) *out*. The *bearing* of the bed, is that direction, in which a line might be drawn across the surface at right angles with the *rise* and *dip*—the *stretch*, or, as it is sometimes called, the *course* of the stratum, is its furthest observable extent in any direction—but, as this is generally on the line of *bearing*, the terms are often used indiscriminately.

†† In Derbyshire, called the *way-board*.

A fissure (*fissura*) may be defined, a partial and, generally, superficial *rift*, mostly of a determinate extent in width and length, and, in depth, rarely extending through more than one *stratum* †.

A vein (*vena*) is a *rift* of a determinate width, but indefinitely extended in depth, and sometimes in length ††.

---

† External rifts, or fissures, are generally frequent in limestone rocks, and are sometimes (in Derbyshire at least) filled with mineral deposits of ore, &c. like the regular, continued rift, or vein.

†† Veins may be divided into *Rake* and *Pipe veins*—to which miners add *flat works;* but these are merely *strata,* or *beds,* worked for the ore which they contain.

Rake veins are rifts intersecting the *strata* (never parallel with them) or mass; of a determinate width, but indefinitely extended in depth and length. Under the *Rake vein,* generally worked for metallic substances, may be ranked the *faults,* or *troubles,* as they are called, in coal soils, whether *dykes, gashes,* or *slips.* These are all real veins (though not often worked as such) filled with mineral substances, distinct from the divided rock. It may not be improper to observe, that the term *slip,* used by miners, does not properly denote the vein itself, but the sudden alteration, which sometimes takes place in the relative height or position of the strata which the vein intersects. This is most remarkable, or rather has been chiefly attended to, in *coal countries;* where the strata, on one side a vein (here called a *dyke, gash, &c.*) are generally found higher or lower than the continuation of the same strata on the opposite side of the vein. This *shifting* or *heaving* of the beds sometimes takes place, where there is no absolute interval or vein formed; the ends or edges of the dislocated beds still remaining contiguous—or, in other words, the *rift,* on which

Obs. The *reliquia* lodged in *veins* and *fissures,* for the most part, differ from those which are inclosed in the surrounding rock †, and are generally of a more recent formation ††.

---

the *slip* has been made, is often too narrow or close to admit the materials, with which the opening would otherwise, in all probability, have been filled, and thus have constituted a vein.

Pipe veins are openings in the strata of a determinate circumference, but indefinitely extended in depth. *Pipe veins,* we believe, are confined wholly to stratified soils. They have generally somewhat of an irregularly tubular form; but in structure and dimensions are found to vary considerably, even in the continuation of the same vein. Their position is, also, very various: they sometimes pierce through the strata in nearly a perpendicular, but oftener in a sloping direction; and not unfrequently are parallel with the beds in which they are found.

† In the *faults* and *troubles* of coal soils, we have known marine remains to occur, while the intersected strata exhibited only vegetal petrefactions—and in the *mineral veins* of the limestone tracts in Derbyshire, wood and other parts of trees are found at the greatest depths, though the rock itself holds only shells and other vestiges of the ocean.

†† Hence the distinction between extraneous fossils *incorporated in the substance of the stratum,* &c. and those *merely lodged in its veins and fissures,* must always be carefully attended to.—The originals of the first kind were undoubtedly contemporary with the formation of the including rock itself, of which they form, as it were, a constituent part; while the extraneous fossils of its veins, in most cases, owe their form to animals or vegetables posteriorly introduced from the surface, by various and often recent operations of nature. We must not here be understood to assert, however, that the *reliquia* of veins, and those of the sur-

** *In substance,*

The *mineral seat* is either *earthy, saline, metallic,* or *inflammable.*

The Earthy (*sedes terrea*) consists of

Limestone, generally in *strata*—including its varieties, as *marbles, swinestones,* &c. Common.
Calc. Spar, in *veins.* Rare.
Marlites, in *strata.* Common.
Marls, in *strata,* very common—in *veins,* rare.
Chalk, in *strata.* Common.
Gypsum, in *strata,* and *masses.* Rare.
Clays, in *strata.* Common.
Shales, in *strata.* Common.

---

rounding strata, are never similar: they are, doubtless, sometimes found to be the same. In such instances, which are by no means common, it is probable, the extraneous fossils of the vein have originated from those primarily lodged in the substance of the strata, but extruded during their desication, and the consequent formation of the *rift.* It will easily be conceived, that those animal or vegetal bodies, which were laid bare by the contraction and splitting of the surrounding mineral matter, would frequently remain adherent to, or sticking in, the surfaces of the fissure then formed; and such, indeed, is the state in which the extraneous fossils of veins, when the same as those of the native rock, frequently present themselves.—During the increase of the *rift,* in its width, by subsequent contraction of the strata, many of these extraneous bodies would be entirely detached, however, from their original matrix; and of course enveloped in the mineral matter, gradually introduced into the vein. (v. p. 25. note. art. 23. 24. and p. 32. note ††.)

Argillite, in *strata*. Common.

Rubblestone, in *strata*. Rare.

Basalt, trap, wacken, and greenstone, in *strata* and *veins*. Very rare.

Sandstones, in *strata*. Very common.

Sand and gravel, in *strata*—sometimes the seat of *woodstone*.

Jasper, in *strata* and *masses*. Very rare.

Porphyry, in *strata*. Very rare. (v. Kirw. G. Ess. p. 247.)

Hornstone or chert, in *strata* and *masses*. Common.

The Saline (*sedes salina*) consists of

Common, or rock salt. Very rare.

The Metallic (*sedes metallica*) consists of

Argillaceous ironstone, in *strata*. Very common.

Bog ironstone, in *masses*. The sest of petrified wood sometimes.

Magnetic ironstone, in *veins*. Rare.

Iron pyrites, in *strata* and *veins*. Rare.

The Inflammable (*sedes inflammabilis*) consists of

Pitcoal, and its varieties, in *strata*. Common.

Peat. Common.

C. 155. THE MATRIX (*Matrix*) is the body of mineral matter immediately adherent to, and generally surrounding, the extraneous fossil.—This is sometimes merely a *part* of the *seat* (152) but is, also, frequently a distinct formation.

The matrix is distinguished according to its *formation, substance,* and *parts.*

* *Formation.*

According to which the matrix is said to be *genuine, spurious, continued, distinct,* &c.

a. 156. A GENUINE MATRIX (*M. genuina*) is formed from the mineral matter which first attached itself to the external surface of the original, organic body.

b. 157. A SPURIOUS OR SUPPOSITITIOUS MATRIX (*M. supposititia*) is formed from mineral matter which has taken place of that originally surrounding the extraneous body.

Obs. In many instances the *true* or *genuine matrix* is removed, and its place and form assumed by other matter. This is frequently the case with the extraneous fossils of veins.

Stones with a sparry or crystalline fracture, and the metallic substances (the iron ores excepted) rarely form any other than supposititious matrices.

c. 158. A CONTINUED MATRIX (*M. continuata*) formed by a part of the seat (152)—not distinct in structure and substance from the seat.

Obs. A continued matrix is mostly a *true* or *genuine* one—Limestone strata are generally *continued matrices.*

d. 159. A DISTINCT MATRIX (*M. distincta*) differing in substance or structure from the *seat*—A distinct matrix may be

Amorphous *(M. amorpha)* without any particular form.—Small masses of *chert,* in limestone beds, frequently afford examples of amorphous matrices.

Nodular (*M. nodularis*) having, more or less, a rounded, or boulder-like form—Examples, nodules of *ironstone, flint,* &c.—These may be globular, ovate, oval, reniform, lenticular, &c.—solid, lamellated, tunicated, &c.

Vein-like *(M. veniformis)* running in a thin, plate-like form, through the solid substance of the seat—A vein-like matrix differs from a true vein, which is sometimes the *seat* of the extraneous fossil, in exhibiting only one compact substance, and in being shut in on all sides by the solid rock; whereas the *true vein* frequently holds a variety of substances, and, in a certain direction, is indefinitely extended. (v. vein. p. 172.) *Spar* and *iron pyrites,* sometimes form vein-like matrices.

Incrusting (*M. incrustans*) covering the extraneous fossil in form of a thin coat or crust—hence, assuming the external shape of the inclosed body †—Example, *tuffstone,* &c.

Subincrusting *(M. subincrustans)* differs from the incrusting, in retaining only a *slight* appearance of the general form of the inclosed body—the coat of mineral matter being too thick to exhibit, externally, the exact figure of the fossil which it covers. *Ironstone nodules* are frequently *subincrusting matrices.*

---

† The common, calcareous incrustations of our rivers, &c. have been ranked as petrifactions; but, with more propriety, may be considered as incipient matrices.

** *Substance,*

According to which the matrix is either

a. 155. Earthy (*M. terrea*).

b. 156. Inflammable (*M. inflammabilis*).

c. 157. Metallic (*M. metallica*).

Obs. The list of minerals already given, under the article *seat,* may be referred to for the substances which are found constituting *matrices.*

*** *Parts.*

The parts of the *matrix* are its *surface* and the *impression* of the organic body.

a. 158. The Surface (*M. superficies*) is the outside or exterior part of a *distinct* matrix—This may be rough, smooth, cellular, chinky, drusy, &c. &c.

b. 159. The Impression (*M. impressio*) is the interior part of the matrix, on which the form of the inclosed body has been impressed †—The matrix is said to be filled (*impleta*) when the reliquium remains in the *impression*—Empty (*vacua*) when the reliquium has been removed from the *impression* †.

---

† Linné, Wallerius, Cartheuser, and others, have considered *impressions*, particularly of compressed bodies, as a distinct mode of petrifaction; but this is evidently incorrect—Every organic body, when first surrounded by mineral matter in a soft or plastic state, must impart the form of its surface to the inclosing mass; and this form will remain, if it be not obliterated by the decay of the organic body, before the investing matter has acquired that

TERMS,

distinguishing the *reliquia* according to their connection with the *soil*.

a.) 160. Ancient (*reliquia vetusta*) forming a part of the constituent matter of the strata in the *most ancient* and *ancient* secondary soils. (a. 130.)

161. Less ancient (*vetula*) forming a part of the constituent matter of the *less ancient* secondary strata ††. (b. 131.)

162. Modern (*recentia*) found in *modern* soils (c. 132.) in which they appear to have been originally imbedded.

163. Very modern (*recentissima*) belonging to

---

degree of hardness, necessary for the retention of the impressed figure. It is certainly immaterial in this process, whether the impression be received from a flat or rounded body: the formation is still the same, and can only be considered as a part of the matrix.

† In many instances, the vacancy left in the matrix, by the decay and gradual removal of the organic body, remains unfilled; no petrifaction being formed in it.

†† The *less ancient* reliquia may sometimes, also, occur in the *veins* and *fissures* of the *ancient* and *most ancient* secon. soils—a. 130.

very modern soils. (d. 133.) *Ancient* and *less ancient* reliquia, when removed from their native beds, sometimes occur in *modern* or *very modern* strata, but are to be distinguished from the genuine reliquia of such soils, by their being rounded or worn, like other travelled materials.

b.) 164. Venigenous (*venigena*) found in *veins*.

165. Stratigenous (*stratigena*) found in *strata*.

c.) 166. Included (*inclusa*) wholly enclosed or surrounded by the matrix or seat.

167. Inherent (*inhærentia*) sticking *in* the surface of the matrix or seat—The extraneous fossils of veins are frequently found in this state.

168. Adherent (*adhærentia*)—when the surrounding stone has been, in a great measure, destroyed by disintegration, leaving the extraneous fossils bare, but adhering by one side to the remaining part of the matrix.

169. Loose (*libera*) not fixed in, or adherent to, a solid matrix or seat—*Very modern* reliquia are frequently in a *loose* state.

170. Vagous (*vaga*) loose, and removed by various operations of nature from the soils in which they were originally imbedded.

d.) 171. Solitary (*solitaria*) single; not many of the same species occurring together.

172. Gregarious (*gregaria*) many of the same species found together or in company.

§. IV.

GEOGRAPHIC SITUATIONS.

The geographic situations (*Loca geographica*) of extraneous fossils are the countries or places where these bodies have been observed to occur—and are either *particular* or *general* †.

1. The particular (*Loca specialia*) are the individual *quarries, mines,* &c. from which the *reliquium* described has been collected.

2. The general (*Loca generalia*) are the *regions, kingdoms,* or *provinces,* in which the described *reliquium* is found.

Obs. The particular geographic situation of an extraneous fossil, when known, should always be carefully noted.

---

† The geographic situation of a reliquium answers nearly to the *loca natalia plantarum,* the native places of *plants,* or their *habitat,* as it is commonly, but improperly, called—This, however, in Botany, includes the soil (*solum*) as well as the region (*regio.* v. Phil. Bot. p. 263. 264.) in which the plants grow—In the description of a *reliquium,* it will always be necessary to particularize the *soil* or geological situation in a separate clause, as this frequently forms a note of distinction to the species or its order, and is at all times of moment in a mineralogical point of view—while the geographic situation is scarcely ever characteristic

§. V.

PRINCIPLES OF ARRANGEMENT.

The arrangements hitherto proposed in systems of extraneous fossils have been drawn from two sources: the *originals*, and the *constituent substances* of these bodies. The first mode, which takes for its principle of distribution into *orders*, *genera*, &c. the *kind* of animal or plant, preserved or represented, is the one which Linnæus has adopted †—The other method, founded on the *constituent* materials, was first proposed by Cronstedt ††—Of these two modes of arrangement, it appears almost needless to observe, that the first is to be preferred—whether we consider the study, as distinct from that of Mineralogy in general, or as forming a part of that science. In either case the

---

of extraneous fossils, though necessary to be known by the collector of these bodies.

† Also Bromel, Wallerius, Woltersdorf, Cartheuser, Vogel, and most other writers who have treated systematically of extraneous fossils.

†† Afterwards adopted by Bergman.—We have not noticed above the *mode* of extraneous fossils, as one of the principles adopted in their arrangements—For though it has been used in conjunction with those we mention, it has never been taken alone, as the foundation of any system.

chief, though not the only end, proposed in the investigation of reliquia, is to acquire a knowledge of their several forms, and of their relations to plants and animals of the present day. This, we may remark, must be obtained, before the study can be of use even to the geologist, to whom, according to some authors, it is *alone* useful—For, it is evidently of little moment to the geologist to know, that certain substances have been found under an organic form, unless the *nature* and *kind* of body imparting that form be also ascertained. It is from this only, as far as extraneous fossils are connected with the subject, that he can reasonably judge of the time and mode of formation of secondary rocks and strata—and it is sufficiently apparent, that the knowledge alluded to will be sooner acquired, from an arrangement founded on the affinity of *reliquia* with the recent subjects, than from one, in which the *constituent* substance gives the leading divisions, and the nature of the organic body is only a secondary consideration.

This principle of arrangement, according to the nature of the *original bodies*, being assumed, the following *divisions* are necessary for the systematical distribution of *reliquia*—CLASS, ORDER, GENUS, Family †, SPECIES, VARIETY, Specimen.

---

† The *primary* or leading divisions used by Linnæus, and now generally adopted in every work on Natural History, are five—Classes, Orders, Genera, Species, and Varieties—In the arrangement of plants and animals, when the *species* are very numerous

The CLASS (*Classis*) is the highest or first *division* in each of the three kingdoms of natural bodies (§. 1) Reliquia may be considered as forming *one class* in the mineral or fossil kingdom.

The ORDER (*Ordo*) is a division of the class †. In the arrangement of extraneous fossils, the *orders* may be founded on the two kingdoms of organic bodies from which they receive their form—namely *animals* and *plants.*

The GENUS (*Genus*) is a division of the order. *Genera* are either *natural* or *artificial* ††.

The *natural genera* of reliquia are those which are founded on the *natural classes, orders,* or other primary divisions of plants and animals. e. g.

---

under a *genus,*—or the *genera* under an *order*—it has been found convenient to separate such *species* or *genera* by *secondary* or *sub*-divisions. In our arrangement of extraneous fossils, we have denominated the subdivisions, under the genus, *families.*

† Orders are usually arbitrary divisions. In Botany, they are confessedly artificial, at least in the Linnean system—adopted to assist the investigation of the genera, by bringing together those that agree in the number and form of certain parts; which agreement is considered as characteristic of such divisions or orders—In a system of extraneous fossils, where the genera are necessarily few, the *order* is scarcely wanted for a division; but we have used it in conformity with the Linnean principles of arrangement.

†† A natural genus, or other division, in Botany and Zoology, is usually considered to be one which comprehends only such species as are naturally allied to each other; and, consequently, agreeing in a great number of external characteristics—an artificial genus, or order, one in which the species arranged under it, evidently differ in most particulars, except those few which have been fixed on as diagnostics of the division.

HELMINTHOLITHUS
ENTOMOLITHUS
PHYTOLITHUS, &c. &c. vide
Linn. Syst. Nat. Wolsterdorf. Syst. Min.
Cartheuser. Min. &c.

The *artificial genera* are those which are founded on the detached *parts* of the original plants or animals, or on the *mode* in which the organic form has been preserved. (§. III. Mode. p. 39.) e. g.

LITHOXYLUM
LITHOBIBLIUM
TYPOLITHUS
INCRUSTATUM, &c. &c. vide
Cartheuser. Min. Vogel. Min. &c. &c.

Natural genera are to be adopted in an arrangement of extraneous fossils—Under artificial genera, a *species* may be separated into *parts,* and consequently will belong to *different genera.*—Or, a *specimen* may exhibit various *modes* of formation, and of course may be arranged in *different genera*—Under natural genera, *one species* can only belong to *one genus.*

In the arrangement of *animal* reliquia the *genera* may conveniently be founded on the Linnean *Classes* of the recent subjects—with reference to the *part* giving the *form,* as being either an *innate* or *fabricated* part of the original †. (§. III. A. 63.)

---

† This is an artificial distinction, but will be found a convenient one, and by no means subversive of the natural divisions—It

On these principles we found 8 genera of animal reliquia; viz.

* Genera dependant on the *innate* parts of animals.

1. Mammodolithus, which contains the reliquia of *Mammalia.*
2. Ornitholithus, -- of *Birds.*
3. Amphibiolithus, -- of *Amphibious Animals.*
4. Ichthyolithus, -- of *Fish.*
5. Entomolithus, -- of *Insects.*
6. Helminthlithus, -- of the *parts* (not fabricated) of *Worms.*

** Genera dependant on the *fabricated* parts of animals.

7. Conchyliolithus, which contains the reliquia of *Shells.*
8. Erismatolithus, -- of *Fulciments* or the fabricated supports of worms (§. III. b. 65.)

In vegetal reliquia, no general distinctions, characteristic of *natural genera,* can be founded on the Linnean Classes or Orders in the sexual system, since these are artificial †—Nor on the natural Orders,

---

affects only the last class of animals—The *Vermes*—which, by the adoption of the principle of arrangement in question, instead of *one* will afford *three* genera of reliquia—These, however, are still natural divisions, as they respectively include only such bodies, as derive their form from species naturally uniting in their recent state.

† Hence, it rarely happens that a detached fossil leaf or stem, &c. can be referred to the class or order, in the sexual system, to

Tribes, or Families, into which Linnæus has elsewhere distributed the vegetal kingdom (v. Phil. Bot. p. 27. 37.) as numberless detached parts of plants occur in the fossil state, which cannot, *at present*, be referred to those divisions—Hence, extraneous fossils that owe their form to plants, can properly constitute but one genus; viz.

1. PHYTOLITHUS †.

The FAMILY (*Familia*) is a subdivision of the *genus*. Families are either *permanent* and *natural*, or *temporary* and *artificial*.

Permanent (*Familiæ permanentes*) contain *permanent species* only (v. species, inf.) and are founded on the *natural* divisions (*genera* or *orders*) of the originals. e. g. *Entrochites*, *Echinites*, &c. Genus HELMINTHOLITHUS,

---

which the original subject belongs—except such fossil owe its form to a plant from a natural family or tribe (viz. *Algæ*, *Filices*, &c.) with which some of the classes in the sexual system agree—On the contrary, the fossil remains of animals, however small or detached the parts may be, are always referable to the classes of their prototypes—For these divisions, in the Linnean arrangement of animals, are established on real and not on factitious distinctions; and under natural tribes, every *part* of an individual will be found impressed with characteristic marks of the division to which nature has assigned it.

† Linnæus appears to have been well aware of the difficulty of forming more than one genus for the fossil remains of plants; and accordingly we find him, even in the last Edit. of the Systema Nat. rejecting the *Lithophyllum*, *Lithoxylon*, *Rizolithus*, &c. of Vogel and other authors, as genera, though he has assumed them as species.

Temporary *(Familiæ temporales)* contain *temporary species* only (v. species, inf.) and are founded on the detached parts of the originals. e. g. *Glossopetræ, Bufonitæ,* &c. Genus ICHTHYOLITHUS—*Lithophylla, Carpolithi,* &c. Genus PHYTOLITHUS.

The SPECIES (*Species*) is a division of the *Family,* or of the *Genus.*

Species, in reliquia, are founded on the *species* of plants or animals to which they owe their form.

ONE SPECIES OF PLANT *or* ANIMAL *can only give form* to one REAL *or* PERMANENT *species of reliquium*—But, the detached parts of reliquia cannot always, in the present state of our knowledge, be referred to their *real* species—species, for a time therefore, must be divided into *permanent* and *genuine,* or *temporary* and *artificial* †.

---

† The temporary or artificial species of reliquia, like the artificial classes of Plants, are succedaneums to the genuine and natural ones—(Artificiales classes succedanea sunt naturalium—Phil. Bot. p. 100.) adopted till a compleat knowledge of extraneous fossils enable us to determine the genuine species, to which these detached parts belong.

Species are the fundamental parts of every system of natural bodies—Until what constitutes the species be determined, and the principle, by which they are characterized, be distinctly ascertained, no arrangement, however ingenious or natural in its other divisions, can prevent confusion—the observation of CÆSALPINUS on *genera,* will with the strictest propriety apply to *species*—for, *confusis speciebus omnia confundi necesse est.*

As far as we are acquainted with the subject, this is the first attempt that has been made to establish a natural and permanen

A Permanent species (*Species permanens s. genuina*) exhibits those *parts* of a plant or animal, which have been selected according to the following principles.

1. The parts must be such as are characteristic of the *order* or *genus* of the original.
2. They must afford sufficiently discriminative *specific marks*.
3. Different *parts* must not be assumed as foundations of *permanent species* in the same family or subdivision of a genus.

---

principle, on which the species of reliquia might be grounded, however obvious or simple that principle may seem.—That the principle in question has occasionally been used, we do not deny—but it never appears as a fixed and fundamental part, in any arrangement of extraneous fossils we have yet consulted—*Linnæus* takes his *species* of these bodies sometimes from the *genera* of the recent subjects (e. g. *Helminthol. Anomites*—*Helm. Madreporus*, &c.) and sometimes from the *tribes* or *orders* (e. g. *Phyt. Filicis*—*Phyt. Plantæ*, &c.) sometimes from the *species* (e. g. *Helm. Craniolaris*, &c.) and sometimes from the *parts* of the originals (e. g. *Phyt. Lithophyllum. Phyt. Lithoxylon*, &c.) *Gmelin*, in the last edition of the *Syst. Naturæ*, is equally destitute of any regular principle in the formation of his species; and, though his arrangement is built on the originals, has assumed, in two instances, the substance of the matrix, as a specific distinction for the inclosed reliquia! (*Ichth. niger*—*Ichth. pallidus*. Syst. Nat. T. III, p. 389.) It is almost needless to add, that *Wallerius*, *Woltersdorf*, *Vogel*, *Cartheuser*, &c. (who have made the originals the foundation of their systems of reliquia) are also wanting in a regular and fixed principle, for the construction of the species they enumerate.

4. When two or more *parts* are fixed on as diagnostics of a permanent species, they must be such as are found *immediately* connected in the recent subject.

5. When permanent species depend on more *parts* than one, similar *parts* in a *detached state* are not to be considered as the foundation of *permanent species*—When the *parts* in question thus occur, they must be arranged as *temporary* species, except they be ascertained to belong to spceies already established, to which they must be referred as *imperfect specimens.* (v. specimen.)

According to the above principles, the *parts* on which *permanent species* may be established are as follows †.

---

† The parts we have fixed on for the construction of permanent species, are those which experience has pointed out, as best calculated for the purpose—Other parts might answer, however, in a certain degree the end we have in view; and perhaps, to many, may appear even preferable to those adopted—It may not be improper, therefore, to state more at large the reasons, that have led to each particular selection—especially in those genera where various parts might have been taken, agreeably to the principles above assumed—1st. In respect to the genus *Mammodolithus*—We must observe, there is no doubt that the united *vertebræ,* and indeed other parts of the skeleton, are as capable of affording characteristic marks of the *orders* and other natural *tribes* in Mammiferous animals, as the bones of the head, if the general knowledge of comparative anatomy were equal to their selection—But it is the *teeth* and their situation in the *head,* on which Linné has chiefly

In the Genus Mammodolithus—The united bones of the *head,* including the *teeth.*

—————— Ornitholithus—The bones of the *head* united to the *bill.*

—————— Amphibiolithus—The united *dorsal vertebrœ.*

—————— Ichthyolithus—The *fins* and *head,* united with the *skeleton* or with the *external covering* of the body.

—————— Entomolithus—The upper *external covering* of the *thorax,* united to that of the *abdomen.*

---

rested the classification of the recent species—these are the parts of the skeleton, therefore, best known to the modern zoologist; and from these, of course, he will most readily determine the natural order or genus of the fossil subjects, and draw with facility permanent specific distinctions—The same reasons will apply to the preference given to the *head* and *bill,* over other parts of the skeleton, in *Ornitholithus*—In *amphibious animals,* the *dorsal vertebræ* afford not only certain, but well known distinctive marks of the genera, to which the fossil remains, hitherto discovered, of this class belong—For instance, in *Testudo* the *vertebræ* are united with the ribs into one solid piece, which constitutes the back shell or covering of the animal. This part, therefore, sufficiently distinguishes the genus from *Rana,* in which the *vertebræ* are destitute of ribs, and both from *Lacerta,* in which proper and distinct ribs are attached to the dorsal *vertebræ*—These are the only genera of *amphibia* (the Linnean order of *Nantes* being excluded the class) that have been observed giving form to extraneous fossils; and of these, the few examples that have occurred, have mostly exhibited the parts in question—The propriety therefore

——————— HELMINTHOLITHUS—various, according to the genus of the originals—e. g.

In reliquia of Pennatulæ—the fins (*pinnæ*) connected with the midrib (*rachis*).

——————— Stylastra—the united joints of the stipe (*stipes*).

——————— Asteriæ—the whole of the *crust* or coriaceous covering of the body.

——————— Echini—the *crust* or calcareous covering of the body.

——————— CONCHYLIOLITHUS—various. e. g.

In reliquia of Bivalves and Multivalves, the united *valves*.

---

of adopting these parts, for the foundation of *permanent species*, will readily be allowed, particularly as they afford sufficient specific differences, especially the dorsal *scuta*, formed by the anchylosed ribs and *vertebræ*, in *Testudo*.—In the next genus of *reliquia*, *Ichthyolithus*, the necessity of taking so many parts, as those above enumerated, for the distinction of permanent species, will not perhaps be apparent—In *Fish*, however, the relative situation of the *fins* is a prime note of distinction in the Linnean Orders, while the structure of certain parts of the *head* and the form of the *body* generally characterise the *genera*—These parts, therefore, are neceſsary to determine the order and genus of the prototype of an Ichthyolithus, according to the Linnean arrangement; and as specimens not unfrequently occur in which they are all visible, we have taken such examples as standards of *permanent species*, rather than those which exhibit only the more detached parts of their originals. In the succeeding genera, *Entomolithus*, *Helmintholithus*, *Conchyliolithus*, and *Erismatolithus*,

——— Univalves (spiral or involuted) the *body whirl* united to one or more of the succeeding whirls—In simple univalves, the whole of the shell.

——— Erismatolithus—various. e. g. In reliquia of cellular Fulciments, the *stirp* exhibiting the internal form or structure of the cells.

——— solid Fulciments, the *stirp* exhibiting its external form.

——— Phytolithus—the *leaf* (includ-

---

it will scarcely be disputed, that the parts selected are those most eligible for our present purpose. With respect to *Phytolithus*, a reason must be assigned, why the parts of *fructification*, (by which doubtless the natural tribes or orders of the originals might best be determined) are rejected, and the *leaf* and *stem* substituted in their place—To those acquainted with the subject of extraneous fossils, it is well known that *flowers* and *fruits* are so rare among the Phytolithi, that to have made *them* the foundation of *permanent* species, would have been nearly the same, as excluding permanent species from the genus. Indeed, the fructification is so minute in one tribe of plants, namely the *Filices*, from which the most numerous, beautiful, and perfect specimens of vegetal reliquia originate, that it is seldom if ever visible in the fossil species, and of course is useless in their discrimination. The *leaf*, therefore, is the part to be preferred, as that from which by far the greatest number of permanent species may be formed—It is the part, also, from which the most certain specific differences may be drawn; and will be found, in conjunction with the *stem*, sufficiently indicative of the natural tribes or orders of plants—at least, as far as these distinctions are applicable to the fossil subjects.

ing the *frond* in *Filices, &c.*) attached to the *trunk* (including the *stem* of herbs, the *culm* of grasses, and the *stipe* of ferns—with the *trunk, caudex ascendens,* in trees)—and the *trunk* alone when ascertained to be *leafless.*

Temporary Species (*Species temporales*) bear the form of such detached *parts* of plants and animals as are not reducible to *permanent species.* e. g.

In the genus MAMMODOLITHUS—the detached *teeth*—bones of the *head*—of the *trunk*—of the *extremities.*

———————— ORNITHOLITHUS—the detached *bill*—bones of the *head, trunk,* &c.

———————— AMPHIBIOLITHUS—the *teeth*—bones of the *head*—detached *vertebræ*—bones of the *extremities.*

———————— ICHTHYOLITHUS—*teeth*—bones of the *head*—detached bones of the *trunk*—*fins*—*scales,* &c.

———————— ENTOMOLITHUS—the detached *head*—*thorax*—*abdomen*—*limbs,* &c.

———————— HELMINTHOLITHUS—

In the reliquia of *Pennatulæ*—the detached *fins,* &c.

———————— *Stylastra*—the detached *body* or *head*—*joints* of the stem, &c.

———————— *Asteriæ*—the detached *rays.*

———————— *Echini*—the *spines, teeth,* &c.—*Nuclei* not referrible to determined species.

———————— CONCHYLIOLITHUS—

In *Univalves*—detached parts of the *spire,* &c.

— *Bivalves* and *Multivalves*——the disunited *valves*—In all, *nuclei* not referrible to established species.

—————— ERISMATOLITHUS—

In *cellular* fulciments—such as do not shew the structure of their cells.

— *solid*—imperfect specimens not reducible to known species.

—————— PHYTOLITHUS—the detached *stem*—*leaf*—*fruit*—*root*, &c.

Temporary species under each genus are to be arranged according to the part which they represent. e. g.

MAMMODOLITHUS.

** *Species temporales.*

† Formâ ossium capitis.

†† ————— corporis.

††† ————— artuum.

&c. &c.

Temporary species must not be unnecessarily multiplied—When two or more detached *parts,* hitherto considered as distinct *temporary species,* are ascertained to belong to *one species* of plant or animal, they must, in future, be arranged as *one species,* under the *part,* which in the original is nearest to that fixed on for the foundation of *permanent species* †.

---

† For example—the detached *stem* and *fruit* of one species of plant have been considered as two distinct *temporary species*—

Temporary species must be reduced to *permanent,* as soon as they are found connected with the *part,* on which the establishment of *permanent species* depend †.

The Variety (*Varietas*) a division of the species, depending on an accidental variation of *form* in the original—Hence *varieties* in the *original species* form *varieties* in the *reliquium.*

Differences of form arising from the loss or presence of an essential part of the original, or from the mode in which the organic form has been preserved (v. modal accid. form. & conditional accid. form. p.p. 72. 73.) do not constitute *varieties* but *specimens.*

The Specimen (*Specimen*) is an *individual reliquium* retained as an example of the *species,* or of

---

when discovered to originate from the same plant, they must be arranged as *one species,* under the division that contains the *stems*—the *stem* being the part immediately connected with the *leaf,* on which the establishment of *permanent species* principally depend.

† The Reduction of *temporary* or *artificial* species into *permanent* and *natural ones,* is an object constantly to be kept in view, by those who systematically cultivate the knowledge of extraneous fossils—the nearer we approach this object, the nearer will the study approximate to that degree of perfection necessary to it as a science—While, on the other hand, a neglect of the principle, we now so strenuously wish to enforce, will, we are convinced, increase the confusion and uncertainty, in which the investigation of reliquia is at present involved.

some affection to which the *reliquium* is subject from a *variation* in the *essential form* (§. III. 33. p. 70.)—from the *mode* or *state* of its mineral change (§. III. Modus. p. 33)—from *accidental form* (§. III. 36. p. 71.)—or from the *constituent substance* (§. III. Substantia. p. 135.)——Specimens, therefore are either

1. *Specimens* of the *Species*—or such as exhibit the *specific characters*—

2. *Specimens* of the *Varieties*—in which the accidental *differences* in the original species are shewn—

3. *Specimens* of the *Mode*—exhibiting the different *states* and *degrees* of mineral change under which the *reliquium* is found.

4. *Specimens of Accidental Forms*—in which variations of figure arising from the *model* and *conditional form* (§. III. 38. 39. p.p. 72. 73.) are present—or

5. *Specimens* of the *Constituent Substances*—which display the various *materials* which have been found constituting the reliquium.

In the *enumeration* of specimens, those which have been collected as particular examples of the *species* and its *varieties* are not to be separately noticed, as they are necessarily included in the *specific* character and general *description* (v. §. VII.).

Specimens of the *mode* are not to be separately described—The *mode* in which the *reliquium usually* occurs may be stated after the *specific character,* and any variations in that *mode* may be noticed under the *specimens* of *accidental forms*, or of the *constituent substances*, accordingly as the variations of the *mode* have occurred in one or other.

Specimens of *accidental forms* are always to be carefully enumerated—If the *accidental forms* in a *reliquium* be not well distinguished, they are liable to be mistaken for distinct, *genuine species* or *varieties*.

Specimens of the *mineral substances* of the *reliquium* (§. III. 181.) should also be enumerated.—Such detail will contain information necessary for the Geologist, though not essential to the discrimination of the species.

§. VI.

PRINCIPLES OF NOMENCLATURE.

The *appellations*, distinguishing extraneous fossils in a systematical arrangement, are generally formed or selected with a reference to the names by which the recent subjects are designated.

Names, in a systematical arrangement, are those of the Class, Orders, Families, and Species.

Name of the Class.

Extraneous fossils, considered as a *class*, have frequently been distinguished by the title of *petri-*

factions (*petrificata*), a term confessedly inapplicable to a large part of the subjects generally ranked under it †. *Larvata* has been substituted in the room of *petrifactions*; but this is, also, an appellation which, in numerous instances, by no means accords with the bodies it is meant to indicate†. Reliquia appears to be a more eligible term, and is at once simple and comprehensive.

---

† Hence, some authors have excluded from the class, as not properly according with the term *petrifactions*, all the unmineralized extraneous fossils; but this is an unnecessary accommodation to a mere name, and deprives the study of a considerable portion of interest, as the remains of plants and animals, occurring in an unchanged state, afford some of the most curious objects of investigation, in the whole circle of natural science. Nor, indeed, as far as respects their systematic arrangement, is there any just principle by which *petrifactions*, properly so called, can be separated from organic remains in the state of *conservata* (§. II. 2. p. 4.)—It will be readily admitted, that the distinctions, under which any tribe or class of natural bodies is distributed into genera or less divisions, ought to be *founded* on those characteristics by which such tribe or class is primarily distinguished from others. It is chiefly, perhaps, in the application of this principle, that the arrangements of Linnæus so greatly excel the systems of preceding naturalists—In his distribution of plants and animal, for instance, the characteristic notes of the *genera* and *subdivisions* are constantly taken from the *figure*, *number*, *proportion*, and *situation* of *essential parts*; the principle on which they are *first* separated into *classes* and *orders*—In the systems left us by Ray and others, in almost every division, some new principle is assumed for the establishment of a diagnostic; and *habitation* and *manners* frequently give character to the last members of an arrangement, begun according to *figure* and *internal structure.*—In

The terms *petrificata* and *conservata* are to be used only in reference to the *modes* of *Reliquia,* not as systematic appellations. (v. §. II. 1. 2.)

Names of the Orders,

May conveniently be formed by that of the *class* joined with terms distinctive of the originals—as, Reliquia Animalia—Reliquia Vegetalia.

Names of the Genera.

The name of a *genus* must form one word only ††—the generic names which have been given to reliquia, forming two or more words, are therefore to be rejected. e. g. *Filix mineralis—Lap. insectiferi*—&c.

---

extraneous fossils, it is the *esssntial form* (§. III. 33. p. 70.) alone which distinguishes these bodies from *minerals,* for the *substance,* even of the *conservata* (§. II. p. 4. et 93. p. 135.) differs only in its organic *structure* from mineral matter—*Form,* therefore, being the principle of their separation from other fossils, it is *form* alone, which must be resorted to, for the foundation of their arrangement under *orders, genera,* and *species*—The *mode* and *substance* of a *reliquium* produce merely accidental distinctions.

† It is not necessary to notice in this place the terms *extraneous fossils, figurate fossils, secondary fossils,* &c. as they are not applicable to a systematic nomenclature, though sufficiently accurate for general use.

†† According to the Linnean Botanical canon—" nomina generica ex duobus vocabulis integris ac distinctis facta, e Republica Botanica releganda sunt." Phyl. Bot. p. 160.

The name of each *genus* of *reliquia* should point out its fossil *state*, and at the same time the particular *order*, *class*, or *kind* of recent subjects, on which such *genus* is founded—A Generic name, therefore, which does not definitively distinguish the *class*, &c. on which it is established, may be objected to, e. g. *Zoolithus*—Generic names which have been given to *reliquia* to distinguish their resemblance, to some class or kind of bodies from which they do not actually derive their form, are also to be rejected. e. g. *Bufonites*—*Siliquastrum*—*Plectronites*, &c.

According to the foregoing principles the names of the genera may be MAMMODOLITHUS, ORNITHOLITHUS, ICHTHYOLITHUS †, &c. v. Syst. Arrangement. P. 2.

---

† It may be objected, that the termination *lithus*, does not point out the general fossil state of *reliquia*, but their actual change into *stone*, and that the names thus compounded are only applicable to *petrifactions*—To this we may answer, there are so many examples in Natural History for the use of terms in a more extended sense, than their original signification warrants, that to reject an established and expressive name, because it does not strictly accord with *all* the bodies arranged under, seems unnecessary—Besides, *lapis* has been used, and consequently so may *lithos* with equal propriety, to express any *fossil* body, without respect to its being *stone*, strictly so called. v. Syst. Nat. E. 12. T. III. " Linnæi Systema *Lapidum*." p. 33.—" Fossilia: lapides ambigui"—&c. p. 34—&c. &c.

Names of the Families.

These are either *permanent* or *temporary*.—The former belong to *permanent*, the latter to *temporary families.* v. p. 187.

The *permanent* may be formed from the systematic names of the recent *genera* or *orders*, on which the permanent families are founded, and the termination *ites.* e. g. *Echinus, Echinites—Trochus, Trochites—Nautilus, Nautilites*; &c.†

The *temporary* may be best formed (when such names are necessary) with a reference to the *part* of the plant or animal from which the family receives its form. e. g. *Rhizolithus, Carpolithus,* &c.

Long established appellations, expressive of a resemblance between reliquia and the parts of plants, animals, or other bodies, from which they have not, however, actually received their form, may be *adopted*, as *temporary family names,* but are not to be *imitated.* e. g. *Glossopetræ, Bufonitæ, Plectronitæ, Mummularii, Lenticularii,* &c.

Names of the Species.

The *name* of a *species* properly consists of the *generic* (i. e. name of the *genus*) and *trivial* name,

---

† The latinity of some of the names, which will follow the application of this rule, may be objected to; but these barbarisms, as they will perhaps be called, can scarcely be more exceptionable than *Witherites, Prehnites, Mellites,* and other terms of like formation, generally adopted in our present systems of Mineralogy.

The *trivial* name is a word added to the name of the *genus,* in order to form a distinctive appellation for a *species.*†

Trivial names applied to *permanent species,* the originals of which are *unknown,* may be taken from various circumstances—1. from *characteristic marks* of the species. e. g. *Phytolithus striatus*—*Phytolithus verrucosus*—&c. &c.—2. from the *countries* in which the species were originally discovered: e. g. *Entomolithus derbiensis*—*Conchyliolithus tirolensis,* &c. &c.—3. from the *resemblance* of the reliquia to other bodies—e. g. *Phytolithus ensiformis*—*Conchyliolithus Sacculus*—*Conch. Pecten.* &c. &c. —4. or from the names of *authors* who have cultivated the study of *reliquia*—e. g. *Conchyliolithus Lesteri*—*Conch. Woodwardii*—*Conch. Plotii.* &c. &c.

---

† In writing or speaking of *permanent* species of reliquia, of which the originals are *unknown,* it will generally be found convenient to use the *family* name, with the *generic* and *trivial* ones—as, CONCHYL. Anomites *striatus*—CONCHYL. Anomites *productus.* &c. &c. In this mode, a more determinate idea is given of the *reliquium,* than if the *trivial* name were used with the *generic* one alone. Nor is the insertion of the *family* name between the *generic* and trivial appellations, as just given, contrary to the practice of our first naturalists, who, in treating of detached species belonging to *genera* in which Linneus found it necessary to establish *families* or *subdivisions,* frequently use the *family* name in conjunction with the *generic* and *trivial* denominations—as, "PHALÆNA Geometra *rufata*—PAPILIO Eques *Hector*—PHALÆNA Tinea *pratella,*" &c.

When the original of a *reliquium* is *known,* the *family* name must of course be omitted, in order to avoid an unnecessary repetition—Vide examples, given in the text, of the formation of the *trivial* names of *species,* whose originals are known in the recent state.

Trivial names applied to *permanent species* whose originals are *known,* must be formed from the names which the original species bear in the most approved systems.

The denomination of a plant or animal being incompleat, except the *generic* be joined with the *trivial* name, both must be used in forming the *trivial* appellation of the fossil species. e. g. CONCHYLIOLITHUS *Anomiæ Gryphi*—CONCHYL. *Ostreæ variæ*—ERISMATOLITUS *Flustræ truncatæ*—&c. &c. †.

In establishing *English names* for the different *permanent* species, it will be found most convenient to take the name of the family only, omitting that of the genus—as, from CONCHYL. Anomites *striatus,* we would form "*the striated Anomite*"—from ERISMATOLITHUS Madreporites *floriformis*—"*the flower-shaped Madreporite*"—&c. &c.

† The use of two words for the *trivial* appellation is contrary to the Linnean canon, that "*the trivial name must form one word only*"—This is a rule, however, which Linné himself has not strictly adhered to; many instances occurring, in the Linnean writings, where an old or long established name, though consisting of two words, is retained as the *trivial* distinction—Thus we have POLYPODIUM *Fil. mas*—POLYP. *Fil. fæmina*—ASPLENIUM

The *trivial name* of *temporary species* should be formed so as to point out, by the termination, the *part* furnishing the *reliquium*. e. g. MAMMODOLITHUS *crinidens*——PHYTOLITHUS *recurvifolius*——PHYT. *nodicaulis*—PHYT. *sulciculmis*—&c.

§. VII.

DELINEATIONS OF RELIQUIA.

Elementary Parts.

The leading parts in the delineation of a reliquium are the *specific character* or *diagnosis*, and the *general description*.

Ruta muraria—ASPL. *Adiantum nigrum*—HELMINTHOLITHUS *Asteria columnaris*. &c. &c. &c.—Where the original of a reliquium is known, we consider the Linnean name, consisting of the *generic* and *trivial* appellations, as the established denomination of the recent species, and retain both words, as the *trivial* name for the fossil. By this, we at once point out the original plant or animal, and at the same time avoid a difficulty that would otherwise arise in distinguishing the reliquia, whose prototypes happen to have the same *nomen triviale* assigned them, in the Linnean system. Thus, for instance, the *Buccinum decussatum* and *Murex decussatum* are both found in the fossil state,

1. THE SPECIFIC CHARACTER (*Differentia specifica*) contains the marks that distinguish the species, to which they belong, from all others in the same genus.

Specific characters of reliquia should be so constructed as to distinguish *permanent* from *temporary species* †; and those, whose originals are *known*, from those whose originals have *not*, as yet, *been discovered* ††. e. g.

1. HELMINTHOLITHUS Echinites spatangites ovalis compressus, ambulacris quinis, areis punctatis.	Permanent Species. The original *unknown* in the recent state.

---

and of course, as reliquia, both come under the genus Conchyliolithus—By retaining the original generic names in the formation of the fossil trivial ones, as CONCH. *Buccini decussati*—CONCH. *Muricis decussati*, the denominations become distinct and appropriate, without any alteration in the term under which the shells are recognized by the conchologist.

† In detached descriptions it will be found convenient to use S. p. or S. t. after the specific distinction, to mark the species as a *permanent* or *temporary* one—The difference in the construction of the *essential characters* may not always strike the eye.

†† This may be done, as in the examples above given, by varying the *termination* of the word which marks the *family* or division of the species—*ites* always being used by us to denote, that the species is known only in the fossil state—In temporary species the word distinguishing the *part*, on which the temporary species is founded, should precede that which points out the order or genus of the original.

2. HELMINTHOLITHUS Echini spatangi ovati gibbi, ambulacris quaternis depressis.	Permanent Species. The original *known* in the recent state.
3. HELMINTHOLITHUS Spinæ Echinitæ, clavatæ crenulato-striatæ, apice punctatæ.	Temporary Species. The original *unknown* in the recent state.

The *specific character* of the recent species of plant or animal frequently depends on parts often or constantly wanting in the fossil subject—Another *diagnosis* must then be given to distinguish the *reliquium*; that of the recent species being marked as a parenthesis.

CONCHYLIOLITHUS Myæ testâ ovatâ postice rotundatâ, striis transversis subinæqualibus (cardinis dente antrorsum porrecto, rotundato, denticulo laterali).

The *generic* and *trivial* names are prefixed to the *specific character*—And, generally, the name of the *family* †, or subdivision of the genus, to which the reliquium belongs—After which must be detailed, in distinct clauses, 1. the *synonyms* or names by which the species has been distinguished by authors, with references to the figures given of it, &c.—2. the *varieties* of the species, with their *synonyms*, &c.—

---

† In forming *families*, or subdivisions under each genus, the reader will observe (v. Syst. Arrangement. P. 2.) that we have strictly adhered to the Linnean system and nomenclature, except in a very few instances—In one of these, we have ventured to separate from the genus ISIS (where Linnæus has placed them) those stellated zoophytes, with crustaceous and generally jointed stems, furnishing the fossil bodies commonly called *Entrochi*, *Asteriæ*, &c.—and, considering them, in the recent state, as a

---

distinct *genus* of worms, have of course formed from their fossil remains a distinct *family*, under HELMINTHOLITHUS.

Indeed it appears singular, that the excellent Linnè should have proposed the animals in question as *Isides*, after the accurate figure and description of one of them, given by our countryman Ellis (Philos. Trans. Vol. LII. p. 357. "Account of an *Encrinus* or *Starfish* with a jointed stem" &c.); but, it is still more strange, that Gmelin should retain them in the genus *Isis*, when he has not hesitated at exchanging its characters, as they stand in the 12. Ed. of the *Systema*, for those given by Solander and Ellis (Natural History of Zoophytes, p. 104) with which the zoophytes, now under consideration, scarcely agree in any one necessary point of discrimination. The truth of this assertion will be manifest, if we attend to the marked distinctions, which nature has placed between these supposed *Isides* and the real or genuine species—In a *true Isis*, the *Isis Hippuris* for example, the *stem* or *coral* consists of a deposition of stony and cartilaginous matter, secreted by numberless polype-like zoophytes, with which it is wholly surrounded—and hence, is really a fabrication like the horny and stony stems in *Gorgonia*, or the cellular corals in *Madrepora*, *Tubipora*, &c. In the supposed *Isides* (*Isis asteria* —*Isis Entrocha*. Linn.) on the contrary, the stem is merely an elongated appendage to a single animal; not clothed, as in *Isides* properly so called, with a living, fleshy mass, or aggregate of zoophytes, but bare;—nor, as in that genus, composed of *solid, stony joints*, connected by intermediate *spongy* or *horny* ones; but consisting of closely united, uniform, crustaceous articulations

3. *vernacular* name—4. the *mode* or state in which the reliquium is generally found—5. its *soil* or geological situation—and 6. its *geographic* situation—after which will follow the general *description*.

---

perforated down the centre by a medullary substance, which, in all probability, conveys life and sensation through this stalk-like part of the animal. The propriety, therefore, of separating the *zoophita* thus formed from the genus *Isis*, must we think be readily admitted: and, as there seems no genus yet established, that can properly receive them, we venture to propose one, with the following characters.

STYLASTRUM.

Character essentialis.

Corpus crustaceum, radiatum, stipitatum : *stipite* sublapideo, plerumque articulato.

Character artificialis.

Corpus crustaceum, stipitatum, sæpissimè fixum, radiatum : radiis (in multis) dichotomis, contractilibus.

Os centrale, quinquedentatum, superum.

Apertura præter os nulla.

Stipes sublapideus, sæpè articulatus : articulis medullâ centrali instructis : suturis crenulatis.

Of this genus, there are no well ascertained recent species, except the two above noticed—the *Isis Asteria* and *Isis Entrocha* of Linnæus. These animals are inhabitants of the Indian seas; and, it is supposed, reside constantly in the most profound depths, firmly attached to stones, rocks, or other fixed bodies. From such depths they appear to be seldom removed, by the agitations, to which the more superficial parts of the ocean are subject—Hence the rare occurrence of recent specimens of these worms. In the mineral kingdom, however, as *reliquia*, not only the two species we are now considering are frequent, but also several others

2. **The Description** (*Descriptio*) **delineates in appropriate terms all the *parts* constituting the *essential form* of the *reliquium,* according to their *number, figure, proportion,* and *situation.***

---

of the same tribe, whose originals have not been discovered. In these fossils there is an essential difference of structure, by which the genus seems naturally divided into two *families*—the species known recent being the most perfect examples of these divisions, with which Naturalists are yet acquainted. The characters of the families may be thus stated.

* Stipite tereti, ramoso; ramis sæpiùs alternis : articulorum discis radiato-striatis : medulâ ex tubis † filiformibus compositâ. *Entrochi.*

†. Hi ad species fossiles foramen quinquelobum sæpè efficiunt.

** Stipite angulato, ramoso; ramis verticillatis : articulorum discis stellâ quinquefidâ †† insculptis: medulâ simplici tenuissimâ. *Pentacrinus.*

††. Radiis, sæpè ellipticis, ex crenis compositis.

To these divisions, in our arrangement of *reliquia,* we have ventured to add a third, for those fossils generally denominated *Caryophyllitæ*—A name, we may remark, which they cannot, with propriety retain, as there is now an established genus of worms under the title *Caryophyllæus,* to which the *reliquia* in question have no relation. These bodies, it is sufficiently evident, derive their form from some species of *zoophyta,* though no recent animals of the kind have yet been discovered—They undoubtedly approach the genus we have been endeavouring to establish, somewhat in structure, but not sufficiently so to be pronounced genuine *Stylastra.* There are no other *Vermes,* however, to which they appear so nearly allied; and as the forming new *genera* from fossil species alone is scarcely allowable, we

The description must primarily refer to the *original* of the *reliquium,* as no just or perfect delineation of the *species* can be given, until the nature of its *prototype* be ascertained.

---

have arranged them, for the present, as now stated. (v. P. II. Gen. HELMINTH. fam. *Stylastritæ.* *** Anthocephalitæ.)

The genus *Stylastrum* should be placed, in a natural distribution of the *Vermes,* near *Asterias,* with which it undoubtedly agrees in many essential characters. In the artificial arrangement of the *class,* adopted by Linnæus, its situation, of course, will be in the *order Zoophyta,* between *Vorticella* and *Hydra,* or between *Hydra* and *Pennatula.* With the first of these *genera* it agrees somewhat in its general form; with *Pennatula* it is connected by a species of zoophyte, which Linnæus, at first, considered as an *Isis,* and afterwards as a Vorticella; but which Bohadsch, Ellis, Pallas, and Gmelin, have arranged with the *Pennatulæ,* or sea-pens. The animal alluded to, is the *Vorticella Encrinus,* Syst. Nat. Ed. 12.—The *Pennatula Encrinus* of the last Ed. of the Systema. This zoophyte, however, is distinguished from *Stylastra* by its compound, clustered head or body, and its stem being destitute of joints—It is sometimes found fossil; and, as it most undoubtedly does not belong to any *genus* in which it has yet been placed, we have arranged it in a distinct *family,* after the *Stylastritæ,* under the title *Encrinites.*

Respecting the term *Encrinites,* we must observe it is a name that has been indifferently applied to *Entrochitæ, Pentacrinitæ,* and the fossil to which we have appropriated it, whenever the body or head of these *reliquia* has occurred in a closed or contracted state, so as to resemble, in some respects, the flower (the Lily) to which the name has reference. In the Linnean system, *Encrinus* is used as the trivial appellation of the animal from which our fossil originates—Hence we have exclusively employed it as the name of the *family* in which this fossil (the only known species) is placed.

The terms, employed in describing *reliquia*, which derive their form from the *external parts* of *animals* and *plants*, must be those used by Zoologists and Botanists of the Linnean school.

Reliquia deriving their form from the *internal parts* of organic bodies, must be described in such *terms* as *Anatomists* would use in distinguishing the same parts in the recent subjects.

As *appendant parts* to the general *description* of the reliquium, must be given—1. an enumeration of the *specimens* which exhibit the various *accidental forms* under which the species has been found—2. an enumeration of the various *substances* which have been observed constituting the reliquium and its matrix.

The constituent substance of a specimen may be merely named, if its identity with some known mineral species be determined. If not, it must be described according to the principles of mineralogy. (v. Werner's External Characters by Weaver—Jameson's Mineralogy. &c.)

Order of the Delineation.

1. *Generic, Family, and Trivial Name.*	HELMINTHOLITHUS ECHINITES *sinuatus.*
2. SPECIFIC CHARACTER.	HEL. Echin. clypeatus convexus, ambulacris striatis areisque de-

cem, verrucis granulorum circulo cinctis. S. p.

3. *Synonyms*, &c. Echinus sinuatus. *Syst. Nat. Ed. Gmel.* 3180.

Polar stone. *Plot. Oxfordsh.* 90. t. 11. f. 9. 10.

Echinites clypeatus, s. maximus, &c. *Luid. Lithop. Brit.* 48. n. 971. t. 13. 971.

4. *Varieties.* *b.* compressior, sinu subobsoleto.

c. ————, sinu profundo.

5. *Vernacular Names.* *Polar stone. Great shield-like Echinite.*

6. *Mode.* Conservatum nucleatum, rarò Petrificatum redintegratum.

7. *Soil.* Sedes : strata vetula, cretacea s. calcareo-margacea : *reliquio* sæpé gregario, nunc incluso, nunc vago.

8. *Geograph. Situation.* England—In a stone-pit near Brackley, Northamptonshire. About Henley, Oxfordshire. Not uncommon in the chalk-pits of Kent and Sussex.

9. DESCRIPTION. *Reliquium* crustale *Echini* hactenus tantum inter fossilia occurrentis. Anus verticalis. Os pentagonum, parvum. Dorsum convexo-depressum, ambitu suborbiculato. Basis leviter concava, sulcis 5 divergentibus ex-

arata. Ambulacra 10, lata, striata, margine utroque punctatis. Areæ verrucosæ; verrucis parvis, granulorum circulo cinctis. Ad unam arearum sinus excavatus, in *Var. b.* profundus; in *var. c.* ferè obsoletus.

10. *Specimens.* SPECIMINA,

Formarum fortuitarum.

a. Sp. complanatum. In arenario fissili. S. rarum.

b. Sp. verrucis carens. *Nucleus.*

Substantiarum consti.

1. Sp. ex cretâ solidâ, matrice continuatâ cretæ.

2. Sp. ex substantiâ organicâ et pyromacho compositum. *Conservatum nucleatum.*

3. Sp. ex margâ induratâ, matrice margæ.

Delineationis Exempla. †

ICHTHYOLITHUS *trigonus.*

ICHTHYOL. Pleuronectites oculis dextris, corpore trigonali, maxillâ superiore longiore, caudâ truncatâ. S. p.

---

† These are not, by any means, offered as complete or correct descriptions, but merely as examples in the application of the

Trans. R. Irish Acad. V. 5. p. 281. t. 4. Large figure ??. ††

Triangular Pleuronectite.

Petrificatum sæpé compositum.

Tractus secund. vetulus, irregulariter ? stratarius, trapezio-argillaceus. *Sedes:* massæ (fragmenta strati ?) superincumbentes, calcario-margaceæ, texturæ recto-schistosæ.

In the quarries of Monte Bolca, Italy. Very rare.

Descr. Rel. postissimùm ossale *Pleuronectis* incogniti. Corpus trigonale, longit. 7—Lat. 6—unc. margine dorsali (ab extremitatibus processuum spinalium superiorum formato) subarcuato, abdominali (extremitatibus processuum spinalium inferiorum et ossiculis thoracis diversis constante) ad pinn. vent. rectangulo. Caput magnum, obtusum. Oculorum orbitæ magnæ, dextræ. Maxilla inferior superiore paulò brevior. Branchiarum opercula subarcuata, glabra. Pinn. pectorales minimæ, rotundatæ. Ventrales minimæ. Dors. et anal.——? Canda integra, magna. Vertebræ thoracis abdominisqure 10. vel 12. caudæ 16.

---

principles and some of the appendant terms, which we have endeavoured to establish in the foregoing pages.

†† We refer to this figure with much doubt: it has the general orm of the specimens from which we made our description; but appears to differ in several particulars: as in the number of the *vertebræ*, shape of the head, &c.

SPECIMINA

Formarum fortuitarum.

a. Sp. complanatum sceleti, pinnâ pect. vent. caudæque manifestis.

b. Sp. ——— sceleti, pinnis omnibus carens.

c. Sp. ——— frustulis externarum corporis partium sceleto adhærentibus. *Petrificatum transmutatum.*

Substantiarum.

1. Sp. ex spato calcario et bitumine † compositum, matrice continuatâ margæ induratæ schistosæ.

ICHTHYOLITHUS *sagittidens.*

ICHTHYOL. dentis Squali, cuspidati ancipitis, margine integerrimo, radice bifurcâ subgibbosâ sursùm bidenticulatâ. S. t.

---

† In the Rev. Mr. Gradon's excellent account of the fossil fish of Monte Bolca (v. Trans. R. I. Acad, above referred to) he observes, that all parts of these *reliquia,* except some of the grosser bones consisting of calcareous spar, are composed of a dark-brown, hard, brittle, and somewhat glossy substance, which he concludes to be the actual dry remains of the animals themselves, preserved or embalmed, as it were, by the calcareous matter of the matrix. We have not had an opportunity of examining many specimens of these fossils; but in the few that have fallen under our notice, the matter in question undoubtedly appeared to us, to have been produced by the original substance of the fish represented; but under a complete change in the combination of its elementary principles; a perfect bitumen being the result, mixed with a small proportion of calcareous earth.

Amphibiolithus Glossopetra. v. subanceps basi bifurca. *Linn. Syst.* 158. 6.

Ichthyolithus Glossopetra. v. subanc—Gmel. Ed. Syst. Nat. 390. 4.

Dentes Squali. *Brand. Foss. Hant.* 42. t. iv. f. 113. 114. 115.

Icthyodontes cuspidati Glossopetra. *Luid. Lithoph. Brit.* 64. 1260—1274.

Varietates.

a. Gracilis sæpè rectus. Ornithoglossum. *Luid. Lith.* 64. 1266—1274. t. 15. f. 1270. 1266.

b. Latus sæpè falcatus. Gracirrhynchus. *Luid. Lith.* 64. 1260—1266. t. 15. f. 1260-1261.

Arrow-shaped Tongue-stone.

Conservatum, rarò Petrificatum.

Tractus varius, secund. vetulus vel recens; nunc cretaceus, nunc margaceus, nunc arenaceus. *Sedes:* strata utplurimum margæ; interdum argillæ vel cretæ, *reliquio* sæpè vago.

In England, near Witney, Northfleet, Hampstead, Milford, &c. On the shores and in the cliffs of the island of Sheppy. Frequent in the islands of the Archipelago; common, also, in Italy.

Descrip. *Rel.* dentale Squali specie nobis ignoti. Long. 1—3 unc. Radix subgibbosa, suprà ad basin cuspidis utrinquè denticulo acuto, nonnunquam duplici, armata; in medio lateris puncto (vestigio tendinis) signata; et in imâ parte bifurca, processibus divaricatis, obtusis, subæqualibus. Cuspis lævigata, anceps, a basi ad apicem acutissimum sensim attenuata, margine integerrimâ. In *var. a.* cuspis gracilis et sæpè recta est; in *var. b.* ad basin lata et sæpissimè arcuata.

SPECIMINA

Formarum. fortuitarum.

b. Sp. apice margineque obtusis (attritis?). S. vagum. Hoc in solis superficiariis, præsertim arenosis vel lutosis, extra sedes natales frequentissimè invenitur.

c. Sp. cuspidis radice spoliatæ.

Const. Substantiarum.

1. Sp. ex materiâ orginicâ, matrice continuatâ cretæ. *Conservatum semi-recens.* Hoc sæpè atrum vel nigrescens.
2. Sp. ex materiâ organicâ, ferro pyritaceo penetratâ, matrice pyritaceâ distinctâ veniformi. *Conservatum imbutum.* Hoc in sedibus margæ nonnuncquam occurrit.
3. Sp. spataceum. *Petrificatum redintegratum.* Inventum in arenario.

CONCHYLIOLITHUS *Muricis antiqui.*

CONCH. Muricis testâ patulo-caudatâ oblongâ stiatâ longitudinaliter costatâ, anfractibus teretibus, labro intus striato. S. p.

Murex antiquus. *Brand. Foss. Hant.* 33. t. vi. f. 74.

Antique Muricite.

Conservatum.

Tractus recens, glareoso-arenaceus. *Sedes:* stratum margæ.

In England, near the village of Hordwell, Lymington, &c. Hampshire.

Descrip. *Rel.* Muricis antiqui Linn. Syst. Nat. Gmel. p. 3546. Long. communiter unc. 3. "Testa oblonga, utrinque acuta, transversim stiata: stiis subinæqualibus; longitudinaliter costata: costis æqualibus. Spiræ anfractus teretes. Columella mutica. Labrum intus striatum" *Foss. Hanton.* p. 33.

Erismatolithus *Parkinsoni.*

ERISM. Milleporites stripe solitariâ cauliformi subramosâ undiquè poriferâ: poris confertis subangulatis subinæqualibus. S. p.

Parkinson's Milleporite.

Petrificatum.

Tractus vestustus calcareous. *Sedes:* strata marmorea.

In England, near Buxton, Derbyshire.*

Descrip. *Rel.* Milleporæ incognitæ. Basis—?. Stirps solitaria, arbuscularis, ferè semipedalis, crassitudine pennæ anseris, subflexuosa, teres, sparsìm ramosa, et undiquaquè cellulis punctata. Cellulæ minutæ, confertissimæ, subæquales, osculis subangulatis.

SPECIMEN. *Subst.*

1. Sp. ex marmore, superficie cretaceâ, matrice continuatâ marmoris. *Petrificatum transmutatum, inhærens.*

In honorem *J. Parkinson,* libri diserti de *fossilibus extraneis* auctoris, hoc *Relequium* formosum nominavi.

PHYTOLITHUS *Sowerbii.*

PHYTOL. Filicites frondibus bipinnatis: pinnulis tripartitis: laciniis lineari-clavatis. S. p.

Sowerby's Filicite.

Petrificatum fucans.

Tractus secund. vetulus, argillaceus, carboniferus. *Sedes.* statum regulare lapidis argillacei (margæ induratæ?)

In England, near Wigan, Lancashire.

DESCRIP. *Rel.* frondale Filicis incognitæ, facie *Lindsææ.* (Linn. Trns. v. iii.) Radix—?. Stipites bi-vel triunciales, graciles, glabri. Frons vix pedalis, subtripinnata; pinnis alternis, patentibus, pinnulis tripartitis, laciniis vel lobis lineari-clavatis, apice sæpè bifidis.

SPECIMINA

Formæ fortuitæ.

b. Sp. pinnis segregatis.

Const. Substan.

1. Sp. carbonaceum, matrice continuatâ lapidis argillacei mollissimi cinerei, texturæ terreæ, fracturâ ad conchaceam accedente, scripturâ albidâ.

In honorem *Jacobi Sowerby,* Soc. Linn. Sod. qui delineationibus accuratissimis *Britanniæ* fossilia nunc illustrat, novo huic et pulchro *Phytolitho* nomen imposui.

END OF THE FIRST PART.

EMENDANDA.

PART II.

⁂ *The reader is requested to correct the following errors of the press, with his pen.*

Page 227, line 19, for multó rarius, write multò rariùs.
229, 17, for sœpé,—sæpè.
230, 21, for longiribus—longioribus.
231, 1, for utraque,—utrâque; et pass.
234, 2, for *Coryphœnitæ,*—*Coryphænitæ;* et pass.
234, 27, for sæpiús,—sæpiùs; et pass.
236, 15, for pinna,—pinnâ; et pass.
——, 27, for Chondroptergiis,—Chondropterygiis.
——, 29, for raro,—rarò; et pass.
239, 16 and 17, for perforatâ, lapideâ, articulata,—perforato, *&c.*
239, 27, for protest,—potest.
240, 8, for cerpore,—corpore.
——, 24, for *Pantacrinitæ,*—*Pentacrinitæ.*
243, 8, for adiatis,—radiatis.
244, 4, for coarctata,—coarctato.
——, 27, for confidamus inveniantur,—speramus invenientur.
245, 18, for collumela,—columellâ.
——, 21, for spiraliâ,—spirali: for gibbos,—gibbosâ.
246, 6, for columella,—columellâ.
247, 21, for Sirpe,—Stirpe.
248, 13, for sèpiùs,—sæpiùs.
——, 27, for innates,—innatas.
249, 9, for remoto,—remotâ.
——, 24, for filii,—filiæ.

OUTLINES.

PART THE SECOND.

SYSTEMA RELIQUIORUM;

OR,

AN ARRANGEMENT

OF

EXTRANEOUS FOSSILS;

AS FAR AS IT RESPECTS THEIR

ORDERS, GENERA, AND FAMILIES.

CONSPECTUS.

§ I. Regni Fossilis *Classes.*

§ II. Reliquiorum *Ordines.*

§ III. ——————— *Genera.*

§ IV. ——————— *Familiæ.*

Sub Gen. 1. **Mammodolitho,**
2. **Ornitholitho,**
3. **Amphibiolitho,**
4. **Ichthyolitho,**
5. **Entomolitho,**
6. **Helmintholitho,**
7. **Conchyliolitho,**
8. **Erismatolitho,**
9. **Phytolitho.**

SYSTEMA RELIQUIORUM, &c.

§. 1.

REGNUM FOSSILE.

* *Fossilia extranea. Forma organica.*

Classis I. **Reliquia.** Fossilia formâ ex animalibus aut plantis ortâ.

* *Fossilia nativa s. Mineræ. Forma anorganica.*

II. Terræ.
III. Salia.
IV. Inflammabilia.
V. Metalla.

Reliquia quasi ea sunt vincula, in universâ serie rerum, quibus connectuntur inter se corpora organica cum mineris. Itaque ex ordine *fossilia extranea,* secundum leges systematis, *mineris* præcedere possunt.

Conservata reliquia sunt animalia et vegetalia corporibus mineralibus vel imbuta vel inclusa. (v. p. 39.) Qualia sunt vegetalia bitumine et ferri vitriolo et pyrite perfusa, nec non animalium et plantarum partes cortice lapideo obductæ, insecta succino immersa, et testæ et ossa quæ e terrâ, vix aut nullo modo mutata, eruuntur.

Petrificata reliquia sunt ex mineris (II. III. IV. V.) conflata, formâ e corporibus organicis ortâ. (v. p. 2.)

§. II.

RELIQUIA.

Forma essentialis organica.

Protypi sæpiùs animalia aut plantæ in statu recenti etiamnum incognitæ.

Substantia vel organica vel mineralis: minerali utplurimum terreâ, interdum inflammabili, rariùs metallicâ, rarissimè salinâ.

Solum plerumquè secundarium, rarò unquam primarium.

§. III.

RELIQUIORUM ORDINES.

I. **Reliquia Animalia.**

Forma essentialis e durioribus animalium partibus enata.

Solum potissimum calcareum.

II. **Reliquia Vegetalia.**

Forma essentialis e partibus plantarum enata.

Solum potissimum argillaceum.

Duriores animalium partes sunt coriaceæ, corneæ, osseæ, testaceæ, lapideæ: tales solùm *Petrificata* præbent; succulentæ enim putrescunt et auferuntur priusquàm natura materiâ minerali defectum supplere potest.

In montibus omnibus stratariis, paucissimis exceptis, animalium reliquia occurrunt, at inter calcareos omninò abundant.

Reliquia plantarum intra strata calcaria, vel etiam silicea in-

§. IV.
GENERA RELIQUIORUM.

Synopsis Generum.

I. RELIQUIA Animalia.

* *Innata.*

Genus 1. MAMMODOLITHUS. *Reliquium* Mammalis.
2. ORNITHOLITHUS. —— Avis.
3. AMPHIBIOLITHUS. —— Amphibii.
4. ICHTHYOLITHUS. —— Piscis.
5. ENTHOMOLITHUS. —— Insecti.
6. HELMINTHOLITHUS. —— Vermis corporis.

** *Fabricata.*

7. CONCHYLIOLITHUS. *Reliquium* Vermis testæ.
8. ERISMATOLITHUS. —— Vermis fulcimenti.

II. RELIQUIA Vegetalia.

9. PHYTOLITHUS. *Reliquium* Plantæ.

---

veniuntur, at multó rarius quam intra argillacea, vel ea quæ solum argillaceum occupant, præsertim si Lithanthracem præbeant.

Genus apud Gmelinum, nempè ANTHROPOLITHI, (v. Syst. Nat. ed. Gmel. p. 386.) hîc omissum est: si enim vera hominùm reliquia fuerint inventa, ea ad MAMMODOLITHUM, absque controversiâ, referenda sunt.

Artificiales Generum Characteres.

I. MAMMODOLITHUS.

Protypus os segregatum Mammalis, rarò sceleton integrum.

Sedes sæpissimè recens.

2. ORNITHOLITHUS.

Protypus rostrum osve segregatum Avis, rarò sceleton integrum.

Sedes recens.

3. AMPHIBIOLITHUS.

Protypus os segregatum Amphibii, interdum sceleton integrum, nunc nudum, nunc loricâ squamisve obtectum.

Sedes vetula vel recens.

4. ICHTHYOLITHUS.

Protypus os segregatum vel sceleton totale Piscis, sæpè squamæ.

Sedes vetula vel recens.

Characterem nullum preterquam factitium *sedes* præbet.

Ornitholithi sunt rarissimi.

Ichthyolithi frequentissimi in stratis secundariis, vetulis vel

5. ENTOMOLITHUS.

Protypus tegmentum Insecti, nunc integrum, nunc mutilatum.

Sedes nunc vetusta, nunc vetula vel recens.

6. HELMINTHOLITHUS.

Protypus Vermis ejusve partes innatæ, potissimè duriores.

Sedes nunc vetustissima, nunc vestusta, nunc vetula vel recens.

7. CONCHYLIOLITHUS.

Protypus Testa fabricata vermis.

Sedes nunc vetustissima, nunc vetusta, nunc vetula, nunc recens vel recentissima.

8. ERISMATOLITHUS.

Protypus Fulcimentum fabricatum vermis.

Sedes sæpè vetustissima, aut recens: rariùs recentissima.

9. PHYTOLITHUS.

Protypus plerumque Plantæ aut truncus aut folium, rariùs fructificatio aut radix.

Sedes utplurimùm vetula: interdum recens aut recentissima: rarò vetusta.

---

recentibus, per totam Europam, rarò inter petrificata montium antiquiorum, qui ætate ad primarios appropinquant, numerantur.

Conchyliolithi in solis secundariis passim obvii sunt.

§. V.
FAMILIARUM CHARACTERES.

Ordo 1. Reliquia Animalia.

Gen. 1. MAMMODOLITHUS.

* *Familiæ Permanentes.*

†.—Primatum. (*Syst. Nat. p.* 21.)

a. *Hominitæ,* dentibus subæqualibus, approximatis.

b. *Simitæ,* dentibus laniariis longioribus, hinc remotis.

††—Brutarum. (*Syst. Nat. p.* 15.)

c. *Bradypitæ,* dentibus molaribus utrinque 6, primo longiore distante.

d. *Rhinocerotitæ,* (cornu in fronte posito.) — ?

e. *Elephantitæ,* dentibus laniariis superioribus elongatis, inferioribus O; molaribus lamellatis.

f. *Trichechitæ,* dentibus laniariis superioribus exsertis; molaribus ex osse rugoso.

†††—Ferarum. (*Syst. Nat. p.* 62.)

g. *Phocitæ,* dentibus primoribus in maxillâ superiore 6, in inferiore 4; laniariis duplò longiribus, remotis, 1; molaribus 5—6.

h. *Felitæ,* dentibus primoribus in utraque maxillâ 6; molaribus 3.
i. *Ursitæ,* dentibus primoribus in utraque maxillâ 6; superioribus excavatis; molaribus 5—6.

††††—Pecorum. (*Syst Nat. p.* 168.)

k. *Cervitæ,* cornibus furcatis, solidis.
l. *Bovitæ,* cornibus simplicibus, tubulosis.

†††††—Belluarum. (*Syst. Nat.* p. 209.)

m. *Suitæ,* dentibus primoribus in maxillâ superiore 4, convergentibus, in inferiore 6 prominentibus; laniariis superioribus 2 bevioribus, inferioribus 2 exsertis.

††††††—Cete. (*Syst. Nat.* p 222.)

n. *Delphinitæ,* dentibus in maxillâ utraque.

** *Familiæ Temporales.*

†—Rel. ossalia capitis.

a.—dentium.
b.—cornuum.
c.—cranii.
d.—maxillarum. &c. &c.

††———— corporis.

e.—vertebrarum.
f.—sterni.
g.—costarum. &c. &c.

†††———— artuum.

h.—clavicularum.
i.—scapularum.
k.—pedum, &c. &c.

Gen. 2. ORNITHOLITHUS.

* *Familiæ Permanentes?*

** *Familiæ Temporales.*

†.—Rel. ossalia capitis.

a.—rostri.
b.—cranii, &c. &c.

††.———— corporis.

c.—vertebrarum.
d.—sterni, &c. &c.

†††.———— artuum.

e.—alarum.
f.—pedum. &c. &c.

††††. Rel. plumarum?

g.—alarum.
h.—caudæ. &c. &c.

Gen. 3. AMPHIBIOLITHUS.

* *Familiæ Permanentes.*

a. *Testudinitæ,* loricâ dorsali e costis coadunatis et vertebris formatâ (corpore caudato: pedibus brevibus subæqualibus.)

b. *Ranitæ,* vertebris distinctis, costis nullis: corpore ecaudato, (nudo): pedibus posterioribus longioribus.

c. *Lacertitæ,* vertebris distinctis, costis propriis: corpore caudato, elongato, (nudo aut squamoso): pedibus æqualibus.

** *Familiæ Temporales.*

†. Reliquia ossalia capitis.

a.—madibularum et maxillarum.
b.—craniorum. &c.

††.————— corporis.

c.—costarum.
d.—sternorum. &c.

†††.————— artuum.

e.—scapularum
f.—clavicularum, &c.

Gen. 4. ICHTHYOLITHUS.

* *Familiæ Permanentes.*

†.—Apodium. (*Syst. Nat.* p. 1132.)

a. *Murænitæ*, corpore teretiusculo, elongato: pinnis d. a. et c. unitis (M. B. radiis 10.)
b. *Ophiditæ*, corpore ensiformi: capite obtuso, nudo: pinnis d. a. et c. unitis (M. B. radiis 7.)

††.—Jugularium. (*Syst. Nat.* p. 1151.)

c. *Gaditæ*, corpore oblongo: pinnis pectoralibus in acumen attenuatis: capite lævi. (M. B. radiis 7.)
d. *Blennitæ*, corpore lanceolato: pinnis ventralibus didactylis: capite declivi (M. B. radiis 6.)
e. *Callyonymitæ*, corpore subcuneiformi: capite labio superiore duplicato: oculis approximatis: aperturis branchiarum ad nucham (M. B. radiis 6.)

†††—Thoracicorum. (*Syst. Nat.* p. 1186.)

f. *Coryphœnitæ,* corpore cuneiformi: capite truncato-declivi: pinnâ dors. longit. dorsi (M. B. radiis 5.)

g. *Scorphænitæ,* corpore lanceolato: capite magno, aculeato: oculis vicinis (M. B. radiis 7.)

h. *Pleuronectitæ,* corpore compresso, ovato-lanceolato, latere altero dorsum, altero abdomen referente: capite parvo, oculis vicinis ambobus in eodem capitis latere (M. B. radiis 4—7.)

i. *Sparitæ,* corpore compresso, oblongo-ovato, lineâ laterali posterius curvatâ, pinnis pectoralibus rotundatis: capite sæpè squamoso, (dentibus validis,) (M. B. radiis 5.) operculis squamosis.

k. *Labritæ,* corpore ovato-oblongo, compresso, dorsalis pinnæ radiis postice ramento filiformi auctis, pectoralibus pinnis acuminatis, lineâ laterali rectâ: capite squamoso, dentibus acutis (M. B. radiis 6.)

l. *Percitæ,* corpore oblongo, scabro, lineâ laterali cum dorso arcuatâ: capite declivi, operculis branchiarum serratis, squamosis, (ore dentibus acutis armato) (M. B. radiis 7.)

m. *Scombritæ* corpore lævi, ovali, lineâ laterali postice carinato: pinnulis spuriis sæpiús versus caudam: capite acuto, compresso, lævi (M. B. radiis 7.)

n. *Triglitæ*, corpore cuneato, sulco longitudinali spinoso ad dorsum, lineâ laterali rectâ: digitis liberis, articulatis, juxta pinnas pectorales: capite magno, loricato, lineis scabris (M. B. radiis 7.)

††††.—Abdominalium.

o. *Cobitiditæ*, corpore subæquali, s. vix ad caudam angustato, pinnâ caudæ rotundatâ: capite parvo, oculis supremis (M. B. radiis 4—6.)

p. *Siluritæ*, corpore elongato, compresso, nudo, radio primo pinnæ dorsalis pectoraliumque retrò dentato: Capite magno, compresso, lato, (M. B. radiis 4—14.)

q. *Salmonitæ*, corpore lanceolato, squamis rotundatis, dorso convexo, recto (pinnâ dorsali posticâ radiis destitutâ): capite lævi, subacuto, compresso, oculis lateralibus (dentibus in maxillis et linguâ.) (M. B. radiis 4—10.)

r. *Esocitæ*, corpore tereti, elongato: capite rostrato supra planiusculo, ore amplo, mandibulis dentatis, inferiore punctatâ, longiore (palato lævi) (M. B. radiis 7—12.)

s. *Mugilitæ*, corpore lanceolato: capite subconico, maxillâ superiore fissâ (sulcatâ, carinam inferioris excipiente), denticulo inflexo supra sinus oris (dentibus nullis) (M. B. radiis 7.)

t. *Exocoetitæ*, corpore oblongo, pinnis pectoralibus longitudine trunci: capite subtrigono, squamoso (maxillis edentulis) (M. B. radiis 10.)

u. *Clupeitæ*, corpore lanceolato, compresso, abdominis carinâ serratâ, pinnâ caudali longâ, bifurcâ: capite subrostrato, compresso (M. B. radiis 8.)

v. *Cyprinitæ*, corpore ovato-oblongo (pinnis ventralibus sæpè 9-radiatis) capite subrostrato (ore edentulo) (M. B. radiis 3.)

††††††—Branchiostegorum.

x. *Syngnathitæ*, corpore subulato, scutis polyedris cataphracto, articulato, pinnis ventralibus 0: capite parvo, rostro cylindrico, longo, apice sursum flexo, ore terminali, operculato, aperturâ branchiarum operculis magnis, striatis clausâ.

y. *Balistitæ*, corpore compresso, squamis (corio coadunatis) et aculeis aspero, pinna ventrali solitaria vel 0: capite compresso trunco fere continuo, inter oculos aliquando spinâ armato, apertura branchiarum angusta supra pinnas pertorales, ore angusto, dentibus utrinque 8, horum anterioribus 2 longioribus.

††††††.—Chondropterygiorum.

z. *Rajitæ*, corpore tenui, depresso, rhomboideo; capite parvo, acuminato, cum pectore quasi continuo, ore sub capite.

In piscibus Chondroptergiis omnia corporis ossa sunt cartilaginea, quâpropter, animalibus emortuis, formam et molem statim amittunt. Chondropterygiorum igitur, non est quod miremur reliquia, præter illa quæ figuram dentium retinent, raró inveniri.

** *Familiæ temporales.*

†. Reliquia ossalia capitis.

a. *Glossopetræ,* reliquia dentium cuspidatorum.
b. *Bufonitæ,* ——— dentium scutelliformium.
c. *Siliquastra,* ——— palatorum dentatorum.
d. Rel. maxillarum.
e. —— branchiarum.
f. —— operculorum.
g. —— radiorum membranæ branchialis.
h. —— cranii &c. &c.

††. ——— ——— corporis.

i. —— vertebrarum.
k. —— sternorum.
l. —— scapularum.
m. —— clavicularum.
n. —— costarum. &c.

†††. ——— ——— artuum.

o. —— radiorum pinnarum.

††††. Reliquia integumentalia.

p. —— squamarum segregatorum, &c. &c.

Glossopetræ dentes Squalorum, *Bufonitæ* dentes molares Anarhicæ esse videntur, sed sine dubio e diversis speciebus. *Siliquastra* vel palati fossiles reliquia formosa gignunt; at vero piscium species pro certo, excepto *Anarh. Lupo,* determinare non licuit.

GEN. 5. ENTOMOLITHUS.

* *Familiæ Permanantes.*

†.—Insectorum apterorum.

a. *Cancritæ,* pedibus 10 s. 8, rariùs 12, primo pari chelato; oculis 2, distantibus, pedunculatis: caudâ articulatâ, plerumquè foliatâ.

b. *Oniscitæ,* (pedibus 14) corpore ovali, laminis imbricatis, transversis tecto; oculis 2, distantibus.

c. *Monoculitæ,* (pedibus natatoriis) corpore crustâ integrâ tecto: oculis 2 approximatis.

††.—Insectorum alatorum ?.

** *Familiæ Temporales.*

†. Reliquia tegumentalia corporis *imaginis* s. insecti perfecti.

a. — thoracis.
b. — pectoris. &c.

††. —— —— artuum —— ——.

c. — pedum
d. — chelarum
e. — caudæ. &c. &c.

†††. Reliquia tegumentalia *larvæ* ?

Alatorum insectorum reliquia, si ulla quidem occurrant, sunt rarissima: quæ adhuc sint descripta paucissima sunt et dubia.

Gen. 6. HELMINTHOLITHUS.

* *Familiæ Permanentes.*

†—Zoophytorum.

a. *Pennatulitæ,* corpore solitario, elongato, stipitato, (libero) pinnato, ossiculo interno: (osculis numerosis ad marginem pinnarum): pinnis lateralibus, denticulatis: stipite subulato.

b. *Encrinitæ,* corporibus radiatis (osculo ad singulum) in umbellam congestis: stipite communi, simplicissimo, enodi, (osseo, membranâ calosâ vestito.

c. *Stylastritæ,* corpore sæpissimè radiato, (contractili: contracto) ovato, vel subrotundo, stipitato, (ore centrali) aperturâ præter os nullâ: stipite columnari, longitudinaliter perforatâ, sæpè ramos laterales emittente, (lapidea) plerumquè articulata, suturis crenulatis.

a. a. *Entrochitæ,* stipite tereti, ramis alternis, remotis, articulis internè trochlearibus: disco radiato-striato; ligamento centrali ex tubis filiformibus 6 composito, sæpè cavitatem obsoletè quinquelobum efficiente.

b. b. *Pentacrinitæ,* stipite angulato, ramis ver-

“Quælibet verò talis pars quinos habet angulos, latera totidem, utrinque quina Lilia, unde *Pentacrinos* Græcè dici protest.” *Agricola. De Nat. Fossilium. L. V.* p. 610.

ticillatis: disco articulorum stellâ, compositâ ex 5 radiis ellipticis crenatis, notato: perforatione centri simplici.

c. c. *Anthocephalitæ*, stipite turbinato, enodi, simplici: corpore? pentagono, quinquedentato.

††.—Molluscorum. (Syst. Nat. p. 3099.)

d. *Asteritæ*, corpore depresso, (coriaceo,) sæpiùs stellato, tentaculis muricato, stipite destituto: ore centrali, aperturâ præter os nullâ.

e. *Echinitæ*, (corpore subrotundo, tecto) crustâ osseâ, et spinis (mobilibus): ore infero a ano dicreto.

a. a. *Anocystitæ*, ano verticali.

b. b. *Spatangitæ*, ano laterali.

c. c. *Brissitæ*, ano infero.

** *Familiæ Temporales.*

a. *Lapides judaici*. Rel. spinarum Echini.

b. Rel. denticulorum Echini.

c. ——. corporis Stylastri. &c.

Synonyma *Pentacrinitæ* sunt Asteria, Asteria columnaris, Encrinus, &c.

Synonymon *Anthocephalitæ* est Caryophillites.

Entrochitæ et *Pantacrinitæ* in calcariis stratiis ubique sunt: at specimina integra rarissimè inveniuntur.

An ad hanc tribum pertinat *Anthocephalites?* Protypus ignotus est.—forsitan *Asterias* inferiore corporis parte elongatâ; forsan species quæ vinculo quodam *Asteriæ* et *Stylastri* genera inter se connectit. In posteriorem sententiam inclinat animus.

GEN. 7. CONCHYLIOLITHUS.

* *Familiæ Permanentes.*

†.—Multivalvium.

a. *Chitonitæ,* valvis sæpè 8, rariùs 7 aut 6, transversè oblongis, dorso incumbentibus.

b. *Lepaditæ,* (testâ basi affixâ) valvis pluribus, inæqualibus, erectis : valvulis stipantibus.

a. a. Balanitæ, utplurimum sessiles, conici, aperturâ terminali, operculatâ.

b. b. (stipitati) compressi, aperturâ sæpè laterali.

c. *Pholaditæ,* valvis 2. divaricatis: valvulis accessoriis difformibus: cardine recurvato.

††.—Bivalvium.

d. *Myitæ,* valvis (utplurimum) æqualibus, inæquilateris sæpiùs transversè ovatis, hiantibus alterâ extremitate: (cardine dente plerisque uno, solido, crasso, patulo, nec inserto testæ oppositæ.)

e. *Solenitæ,* valvis utplurimum æqualibus, inæquilateris, oblongis, utrâque extremitate hiantibus (cardine dente subulato, reflexo, sæpè gemino, nec inserto testæ oppositæ.)

f. *Tellinitæ,* valvis utplurimum æqualibus, inæquilateris, transversè ovatis, aut suborbiculatis, antice hinc ad alterum latus flexis (cardine dentibus tribus, lateralibus alterius valvæ planis.)

g. *Carditæ,* valvis æqualibus subæquilateris suborbiculatis, plerumque valdè convexis, longitudinaliter costatis, striatis aut sulcatis, marginibus dentatis (cardine dentibus mediis, binis, alternatis, altero utplurimum incurvo, lateralibus remotis insertis.)

h. *Mactritæ,* valvis æqualibus inæquilateris, transversè ovatis aut trigonis, (cardine dente medio complicato cum adjectâ foveolâ, lateralibus remotis, insertis)

i. *Donacitæ,* valvis æqualibus, inæquilateris, sæpè ovatis aut cuneatis, margine utplurimum crenulato, antico obtusissimo (cardine dentibus duobus, marginalique solitario, subremoto sub ano.)

k. *Veneritæ,* valvis æqualibus, inæquilateris, sæpè ovatis aut orbiculatis, labiis margine antico incumbentibus (cardine dentibus tribus approximatis, divergentibus) vulvâ et ano distinctis.

l. *Spondylitæ,* valvis inæqualibus, inæquilateris, sæpè suborbiculatis, rigidis, interdum subauritis (cardine dentibus duobus, recurvis, cum foveolâ intermediâ.)

m. *Chamitæ,* valvis sæpius subæqualibus, plerumquè inæquilateris, subrotundis, grossioribus (cardine callo gibbo, obliquè inserto fossulæ obliquæ).

n. *Arcitæ,* valvis æqualibus, inæquilateris, oblongis aut rotundatis, cardine sæpè recto (dentibus numeroris, acutis, alternis, insertis.)

a. a. Cardine recto

b. b. Cardine arcuato

n. *Ostracitæ,* valvis (plurimis) inæqualibus, plerumque inæquilateris, sæpè semiorbiculatis, subauritis (cardine edentulo, fossulâ cavâ ovatâ, sulcisque, in plurimis, lateralibus transversis.)

a. a. Pectinitæ, valvis auriculatis adiatis, cardine recto.

a. a. a. auriculis æqualibus.

b. b. b. auriculis inæqualibus.

b. b. Ostracitæ, vulgo dicti, valvis non auritis, rudibus, sæpè lamellatis.

p. *Anomitæ,* valvis inæqualibus, æquilateris, alterâ nate magis productâ, sæpiùs incurvatâ, perforatâ (cardine edentulo, aut in valvâ alterâ duobus dentibus sæpè uncinatis, alterâ crenis accipientibus prædito.)

a. a. Gryphitæ, imperforati, *valvâ* alterâ planâ: cardine curvo, arcto.

b. b. Imperforati, *valvâ* alterâ planâ, *cardine* recto, extento, coarctato.

c. c. Perforati, *valvâ* alterâ planâ.

d. d. Perforati, *valvâ* utrâque convexâ, *cardine* valvæ (plerumque) majoris recto, patulo, secto inter nates *foramine* trigono, magno.

a. a. a. cardine extento.

b. b. b. cadine curto.

e. e. Perforati, *valvâ* utrâque convexâ, *nate* valvæ convexioris incumbente, sectâ infra apicem *foramine* exiguissimo, trigono aut oblongo, *cardine* coarctata, curvo.

f. f. *Terebratulitæ,* perforati, *valvâ* utrâque convexâ, *nate* valvæ convexioris pertusâ *foramine* tubulato, *cardine* coarctato, curvo.

q. *Mytilitæ,* valvis æqualibus, inæquilateris, obliquè vel longitudinaliter ovatis, rudibus (sæpiùs affixis bysso: cardine edentulo, distincto).

a. a. Valvis non auritis, ventricosiusculis.

b. b. *Margaritiferitæ,* valvis auritis, subcompressis, cardine rectissimo, extento.

r. *Pinnitæ,* valvis subæqualibus, inæquilateris, erectis, triangularibus, hiantibus, sæpè squamosis, (affixis bysso, in unam coalitis, cardine edentulo.)

†††.—Univalvium.

s. *Nautilitæ,* testâ dissepimentis perforatis concameratâ, polythalamiâ.

Numerosa anomiarum fossilium tribus in varias series a variis divisa fuit. Divisiones nostræ de foramine et cardine pendentes, qui procul dubio characteres præstantissimos præbent, aptæ, ut confidamus, inveniantur.

a. a. Involuti.

b. b. *Ammonitæ,* spirales, anfractibus manifestis, depressis.

c. c. Spirales, anfractibus manifestis, elevatis.

d. d. Rectiusculi, elongati, apice spirali.

e. e. *Orthoceratitæ,* recti, elongati, ab apice ad basin concamerati.

f. f. *Belemnitæ,* recti, elongati, basi cavitate conicâ concameratâ excavati, apicem versus solidi.

t. *Conitæ,* testâ convolutâ, turbinatâ, *aperturâ* effusâ, longitudinali lineari, edentula, basi integrâ, columellâ lævi.

u. *Cypræitæ,* testâ involutâ, subovatâ, lævi, *aperturâ* utrinque effusâ, lineari, utrinque dentatâ.

x. *Bullitæ,* testâ convolutâ, lævi, *aperturâ* subcoarctatâ, oblongâ, longitudinali, basi integerrimâ, *collumela* obliquâ, lævi.

y. *Volutitæ,* testâ spirali, *aperturâ* ecaudatâ, subeffusâ, *columellâ* plicatâ, *labio* interiore nullo.

z. *Buccinitæ,* testâ spiraliâ, gibbos, *aperturâ* ovatâ, desinente in canaliculum dextrum, caudâ retusum, seu lacunam retusam, *labio* interiore explanato.

a 2. *Strombitæ,* testâ spirali, latere ampliatâ, *aperturâ* labro sæpiùs dilatato, desinente in canalem sinistrum.

b 2. *Muricitæ*, testâ spirali, exasperatâ suturis membranaceis, *aperturâ* desinente in canalem integrum, rectum seu subadscendentem.

c 2. *Trochitæ*, testâ spirali subconicâ, *aperturâ* subtetragono-angulatâ, superiús transversâ, coarctatâ, *columella* obliquatâ.

d 2. *Turbinitæ*, testâ spirali, *aperturâ* coarctatâ, orbiculatâ, integrâ.

e 2. *Helicitæ*, testâ spirali, *aperturâ* coarctatâ, intus lunatâ s. subrotundâ: segmento circuli demto.

a. *a*. Depressi.
b. *b*. Globosi.
c. *c*. Subconici s. ovati.

f. *Neritìtæ*, testâ spirali, gibbâ, subtus planiusculâ, *aperturâ* semiorbiculari, labio columellæ transverso, truncato, planiusculo.

g 2. *Haliotiditæ*, testâ auriformi, patente, *spirâ* occultâ, laterali, *disco* longitudinaliter poris pertuso.

h 2. *Patellitæ*, testâ subconicâ absque spirâ.

i 2. *Dentalitæ*, testâ tubulosâ, liberâ, utrâque extremitate perviâ, sine spirâ, rectâ.

k 2. *Serpulitæ*, testâ tubulosâ, adnatâ, sæpè contortâ, alterâ extremitate integrâ.

GEN. 8. ERISMATOLITHUS.

Familiæ Permanentes.

†.—fulcimentorum externorum.

A. Coralliorum.

a. *Tubiporitæ,* fulcimento tubulato, (lapideo,) sæpè aggregato: tubulis plerumquè dissepimentis vel ramis tubulosis connexis.

b. *Medreporitæ,* fulcimento (lapideo:) cellulis lamelloso-stellatis.

- *a. a.* Fulc. proprio, stellâ unicâ.
- *b. b.* Fulc. commune, stellis pluribus.
  - *a. a. a.* Stirpulis consociatis, scapiformibus.
  - *b. b. b.* Stirpe cumulato, stellis distinctis, orbiculatis.
  - *c. c. c.* —— ————, stellis distinctis, angulatis.
  - *d. d. d.* —— ————, stellis conjunctis, concatenatis.
  - *e. e. e.* —— ————, stellis conjunctis, conglomeratis.
  - *f. f. f.* Sirpe arbusculari, stellis terminalibus.
  - *g. g. g.* —— ————, stellis lateralibus, plerumquè remotis, interstitiis integris.
  - *h. h. h.* —— ————, stellis lateralibus, plerumquè approximatis, interstitiis porulosis.

c. *Milleporitæ,* fulcimento (lapideo:) cellulis poriformibus.

d. *Celleporitæ,* fulcimento (sublapideo:) cellulis urceolatis.

B. Corallinarum.

e. *Sertularitæ,* fulcimento sæpiùs articulato, (corneo,) arbusculari, tubulato, receptaculis ordinatis, sæpè lateralibus, calyciformibus s. dentiformibus.

f. *Tubularitæ,* fulcimento sæpiùs articulato, (corneo,) tubuloso: tubis continuis s. ramosis, sæpè articulatis, osculis terminalibus.

g. *Flustritæ,* fulcimento sèpiùs continuo, foliaceo, ex seriebus coadunatis cellularum ringentium composito.

h. *Corallinitæ,* fulcimento articulato, sæpè dichotomo, (filamentoso,) superficie (calcareâ,) porosâ.

††.—Fulcimentorum internorum.

i. *Isiditæ,* fulcimento (lapideo,) arbusculari, internodiis articulato: articulis longitudinaliter striatis.

k. *Gorgonitæ,* fulcimento (lignoso, corneo vel testaceo) arbusculari, continuo.

An ex cæteris *zoophytorum* generibus, nempe ex ALCYONIO, HYDRA et SPONGIA, Erismatolithus unquam oriri posset, multum dubito. HYDRÆ non nisi partes innates præbent, et ALCYONIA simul cum ossiculo interno sive fulcimento (e. g. Alcy. arboreum et Alcy. exos Linn. quæ petrifacta occurrunt) natura ad

Order II. Reliquia vegetalia.

GEN. 9. PHYTOLITHUS.

* *Familiæ permanentes.*

a. *Algitæ,* radice, trunco aut foliis distinctis nullis.

b. *Muscitæ,* caule distincto, filiformi; foliis simplicibus, sæpissimè confertis, imbricatis, sessilibus, (membranaceis, reticulatis, persistentibus: capsulâ calyptratâ, remoto a flore masculo.)

c. *Filicitæ,* fronde utplurimum pinnatâ, (paginâ inferiore fructificante.)

d. *Graminitæ,* culmo articulato, foliis simplicissimis, sæpè alternis, lineari-lanceolatis: (calyce glumoso; semine unico.)

e. *Palmitæ,* caudice simplice, apice frondosâ: (fructificatione in spadice cum spathâ.)

f. *Plantitæ,* dicuntur reliqui *phytolithi* qui priores intrare nequeunt familias. (v. Phil. Bot. p. 37.)

GORGONIAS referre videtur. Forsan ALCYONIA vera magis sunt destructioni obnoxia quam ut reliquia formarent; et certe, quas spongitas Autores vocare solent, eæ verarum spongiarum non sunt filii.

Algæ et Musci fossiles rarissimi. Fungi fossiles nondum reperti sunt. *Fungitæ* Authorum sunt *Madreporitæ* simplices.

** *Familiæ Temporales.*

a. *Antholithi,* reliquia floralia ?
b. *Carpolithi,* ——— fructualia.
c. *Lithophylla,* ——— foliaria.
d. Reliq. truncalia.
    a. a.—culmalia.
    b. b.—caulina.
    c. c.—caudicalia.
        a. a. a.—corticalia.
        b. b. b.—lignalia.
e. *Rhizolithi,* reliquia radicalia.

Fam. *c. c. a. a. a. &c.* secundum legem botanicam ad fam. e. referri possunt, quoniam partes arborum quæ vulgò trunci vocari solent profectò sunt radices ascendentes. (Caudices ascendentes. Linn. Phil. Bot. p. 38.)

FINIS.

J. Wilson, Printer, Macclesfield.

14 DAY USE
RETURN TO DESK FROM WHICH BORROWED

EARTH SCIENCES LIBRARY

This book is due on the last date stamped below, or
on the date to which renewed.
Renewed books are subject to immediate recall.

~~MAY~~ [illegible]
~~JUN 1 1964~~
~~AUG 13 1964~~
~~3 1 19~~65
~~MAR 31 19~~70

LD 21–50*m*-4,'63
(D6471s10)476

General Library
University of California
Berkeley

U.C. BERKELEY LIBRARIES

C034666473

Storage

QE710
M3
-464